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See Page 43

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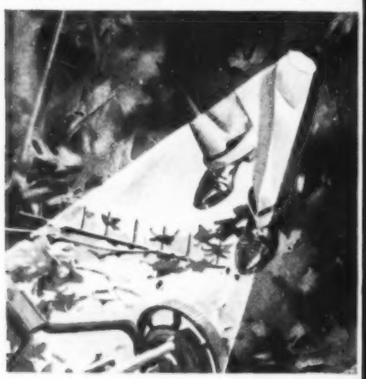
BUY Eveready and you buy *fresh* batteries. Your dealer sells them so fast that, when you buy yours, he can assure you *they're fresh* . . . and prove it by the "Date-Line" on each battery.

But *freshness* is only a part of Eveready's superiority. Inside the zinc case, there's a patented Eveready "power-stabilizer." It holds a balanced mix of the six active chemicals in perfect alignment . . . ready to light instantly. While outside, sealing in freshness and power, there's a spun metal top.

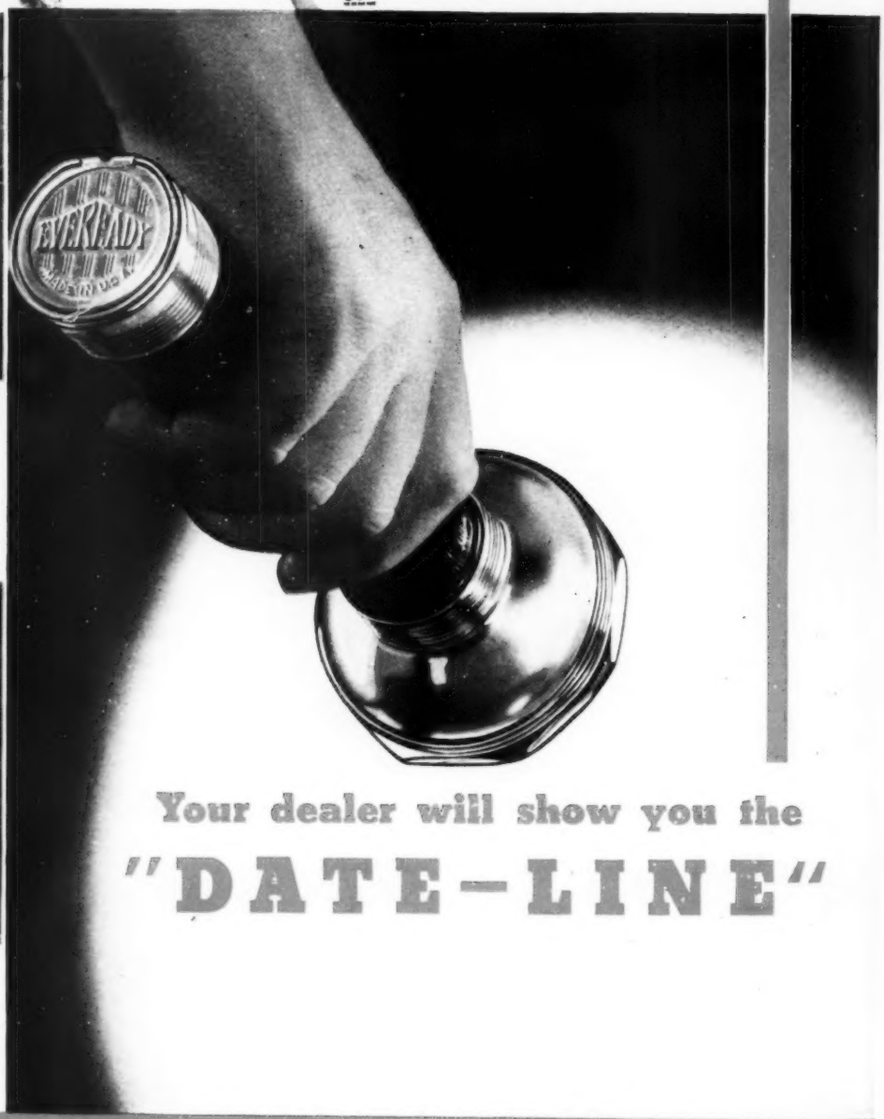
Back of the "Date-Line" which guarantees Eveready *freshness* there's work . . . and lots of it. But it's work that pays us . . . and you, too . . . for it brings you the comforting knowledge that in buying an Eveready for your flashlight, radio, or motor ignition you're buying packaged electricity at its *freshest* and best.

National Carbon Company, Inc., General Offices, New York, N. Y.
Unit of Union Carbide and Carbon Corporation.

AT TIMES LIKE THESE YOU'RE GLAD THEY'RE FRESH. Awakening to discover an intruder in her home, Mrs. Peter Bradbury*, wife of a prominent banker, courageously ignored the man's threats, turned a flashlight on his face and called for help. The intruder escaped . . . but thanks to her courage and foresightedness her family was safe. **Not her real name, although it was given in the coast-to-coast newspaper report.*



AT TIMES LIKE THESE YOU'RE GLAD THEY'RE FRESH. Johnny might be a great little helper but the chances are he's a bit careless . . . and there are painful results from stepping on the garden rake. Play safe, shoot the brilliant beam of your Eveready ahead of you when walking outside in the dark.

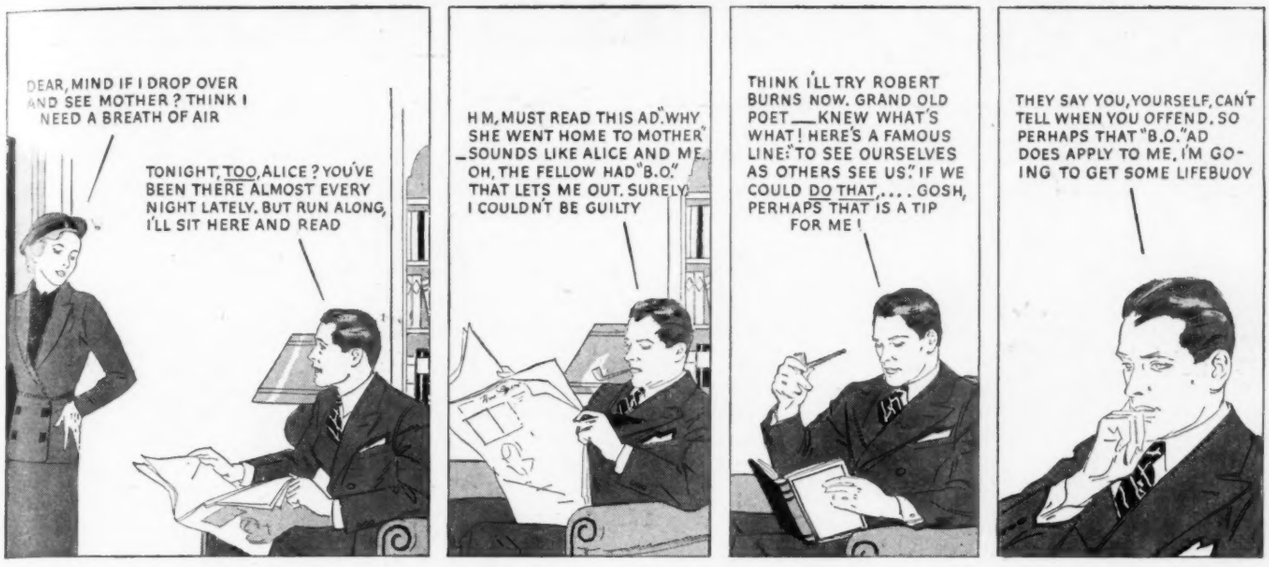


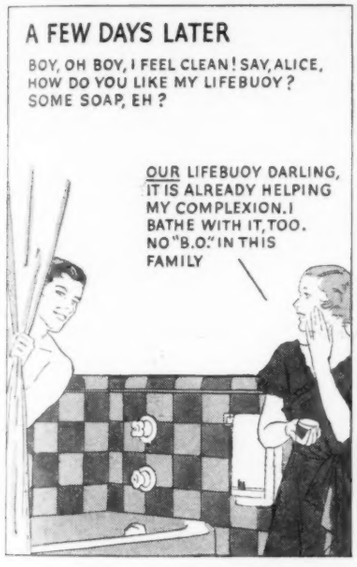
Your dealer will show you the

"DATE-LINE"

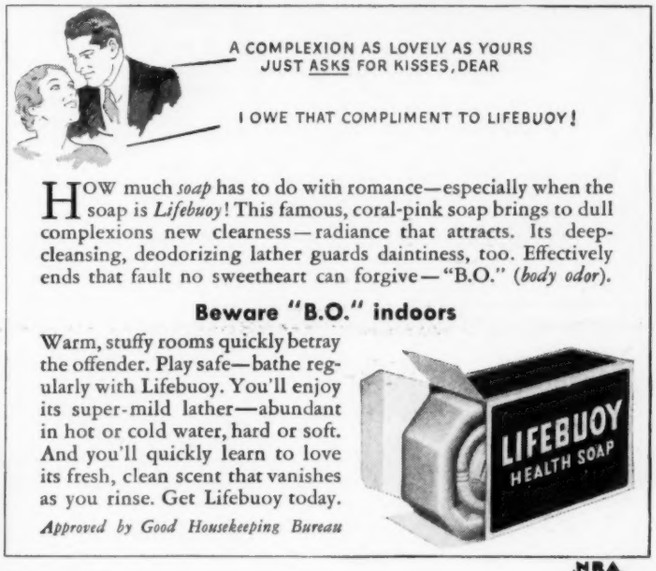
EVEREADY BATTERIES *packaged electricity at its best*

IF WE COULD SEE OURSELVES AS OTHERS SEE US


DEAR, MIND IF I DROP OVER AND SEE MOTHER? THINK I NEED A BREATH OF AIR
TONIGHT, TOO, ALICE? YOU'VE BEEN THERE ALMOST EVERY NIGHT LATELY. BUT RUN ALONG, I'LL SIT HERE AND READ
HM, MUST READ THIS AD. "WHY SHE WENT HOME TO MOTHER" SOUNDS LIKE ALICE AND ME. OH, THE FELLOW HAD "B.O." THAT LETS ME OUT. SURELY I COULDN'T BE GUILTY
THINK I'LL TRY ROBERT BURNS NOW. GRAND OLD POET — KNEW WHAT'S WHAT! HERE'S A FAMOUS LINE: "TO SEE OURSELVES AS OTHERS SEE US." IF WE COULD DO THAT,.... GOSH, PERHAPS THAT IS A TIP FOR ME!
THEY SAY YOU, YOURSELF, CAN'T TELL WHEN YOU OFFEND. SO PERHAPS THAT "B.O." AD DOES APPLY TO ME, I'M GOING TO GET SOME LIFEBUOY


A FEW DAYS LATER
BOY, OH BOY, I FEEL CLEAN! SAY, ALICE, HOW DO YOU LIKE MY LIFEBUOY? SOME SOAP, EH?
OUR LIFEBUOY DARLING, IT IS ALREADY HELPING MY COMPLEXION. I BATHE WITH IT, TOO. NO "B.O." IN THIS FAMILY

"B.O." GONE — cozy evenings for two!
WE'RE GETTING TO BE TWO OLD STAY-AT-HOMES, DEAR. PERHAPS WE OUGHT TO SEE A SHOW TONIGHT
DARLING, I'M SO HAPPY JUST BEING WITH YOU THAT I DON'T CARE IF I NEVER GO OUT!



HOW much *soap* has to do with romance—especially when the soap is *Lifebuoy*! This famous, coral-pink soap brings to dull complexions new clearness—radiance that attracts. Its deep-cleansing, deodorizing lather guards daintiness, too. Effectively ends that fault no sweetheart can forgive—"B.O." (*body odor*).

Beware "B.O." indoors

Warm, stuffy rooms quickly betray the offender. Play safe—bathe regularly with Lifebuoy. You'll enjoy its super-mild lather—abundant in hot or cold water, hard or soft. And you'll quickly learn to love its fresh, clean scent that vanishes as you rinse. Get Lifebuoy today.

Approved by Good Housekeeping Bureau

A NEW SHAVING SURPRISE!

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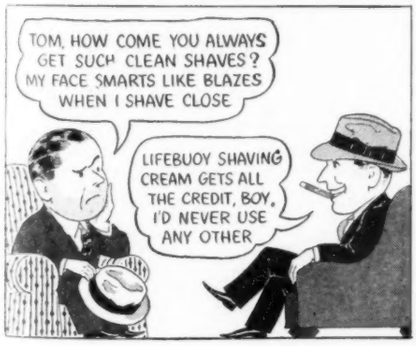
TOM, HOW COME YOU ALWAYS GET SUCH CLEAN SHAVES? MY FACE SMARTS LIKE BLAZES WHEN I SHAVE CLOSE
LIFEBUOY SHAVING CREAM GETS ALL THE CREDIT, BOY. I'D NEVER USE ANY OTHER

BUT REMEMBER, TOM, I'VE GOT WHISKERS LIKE WIRE AND A MIGHTY TENDER FACE
LIFEBUOY'S EXTRA-MOIST LATHER IS JUST MADE FOR THAT COMBINATION OLD TOP, TRY IT

You can't beat this new extra-moist, soothing lather

Does your face get that seedy, "I need a shave" look before evening? Then try this new extra-moist lather. Lifebuoy Shaving Cream lather doesn't dry up or break down on your face. It holds 52% more moisture. *Soaks* stiff beards soft—*extra soft*. The razor gets off every whisker clean—for smooth, close, all-day shaves. And it soothes tender skin. Try it. Get the big, red tube at your druggist's. Or write Lever Brothers Co., Dept. A1411, Cambridge, Mass., for a free 12-day tube.

(This offer good in U. S. and Canada only.)

120 TO 150 SHAVES IN THE BIG, FULL-SIZED TUBE

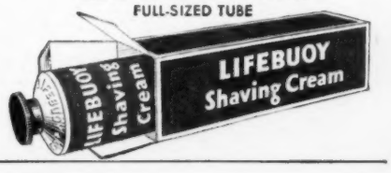

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TABLE OF CONTENTS for NOVEMBER, 1934

Sensational Study of Heredity May Produce New Race of Men . 15
STERLING GLEASON *tells how X-rays and black light reveal secrets of life*

Amazing New Uses Found for Glass 18
Latest marvels of America's oldest industry, described by EDWIN TEALE

Border Guard Wages War on Smugglers 26
High adventure with ANDREW R. BOONE *on the trail of fearless outlaws*

Fiends of the Desert Found to be Harmless 30
GORDON GORDON *tells how science exploded myths of deadly reptiles*

Mysterious Lost Rivers Run Mills and Power Plants 36
The harnessing of underground streams, explained by WALTER E. BURTON

Homemade Planetarium for Amateur Astronomers 46
GAYLORD JOHNSON *shows hows to reproduce the movements of stars at home*

World's Strangest Circus Produced by Amateurs 49
The remarkable feats of a group of ambitious Texans, described by A. MORTON SMITH

You Can Grow Mushrooms in Your Cellar 54
Expert advice to insure success in a fascinating and profitable business

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FEATURES AND DEPARTMENTS

Improve Your Heating System . 6
Our Readers Say 12
The Man With the Net 33
Flowers' History in Microscope . 40
Scientific Tests at Home . . . 53
Safe Experiments with Fire . . 56
New Household Devices . . . 58
Short Wave Superheterodyne . . 60
Hints for Radio Fans 62
Here's the Answer 63
Watch Your Ammeter 64
The Home Workshop 65
Making Lifelike Portraits . . . 74
Kinks for Your Car 76

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AUTOMOBILES

Fan Cools Auto Tires 23
Dachshund Car Marks Road . . 23
Scout Car Has Monorail Tires . 25
Steering Wheel Folds 32
Light Gives Turn Signal . . . 34
Models Reproduce Accidents . . 35
Puts On Chains Automatically . 39
Traffic Sign Sinks When Hit . . 45

AVIATION

New Plane's Wing Folds . . . 20
Push-Button Airplane 21
"Pterodactyl" War Plane . . . 22
Twenty-Five Jumpers in Air . . 25

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Evolution
Heredity, Sex
Embryology

BUSINESS
Finance
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Elements
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Formulas
Processes

ECONOMICS
Production
Consumption
Capital, Labor

EDUCATION
Public
Industrial
Universities
Museums

ELECTRICITY
Radio, Television
Motors
Dynamos
Measurements
Transmission
Telephony

ENGINEERING
Mining
Bridges, Dams
Tunnels
Hydraulics
Surveying
Road-Building

EXPLORATION

FINE ARTS
Sculpture
Painting
Etching
Wood Carving
Printing

FORESTRY

GAMES AND SPORTS
Contract Bridge
Baseball
Football, Golf

GEOGRAPHY
Mountains
Oceans, Rivers
Cities

GEOLOGY
Rocks, Fossils
Minerals
Earthquakes

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Constitutions
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Wars, Alliances
Revolutions

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Landscaping
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INTERIOR DECORATION
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Furniture
Rugs, Carpet
Tapestries

INVENTION
Airplane
Automobile
Oil Burners
X-Rays
Wireless

LAW
Property
Crime, Civil
Commercial
Administrative

LITERATURE AND DRAMA
Poetry, Novels
Satires, Fables

MANUFACTURING
Textiles
Leather, Glass
Vehicles
Ceramics
Steel, Cotton
Machinery

MATHEMATICS
Arithmetic
Algebra
Geometry
Trigonometry
Calculus

MEDICINE
Prophylaxis
Pathology
Therapeutics
Surgery, Drugs

MUSIC
Opera
Orchestra
Dance, Sacred
Instruments

PHILOSOPHY
Plato, Spinoza
Schopenhauer
Spencer, Dewey

PHYSICS
Heat, Light
Magnetism
Radioactivity
Acoustics

PHYSIOLOGY
Bones, Muscles
Nerves
Circulation
Respiration

RELIGION
Brahmanism
Buddhism
Judaism
Christianity
Mohammedanism

SOCIOLOGY
Marriage
Defectives
Criminals
Unemployment
Prostitution

WORLD WAR
Alliances
Campaigns
Actions

ZOOLOGY
Form, Habit
Reproduction
Instinct
Habitat
etc., etc., etc.

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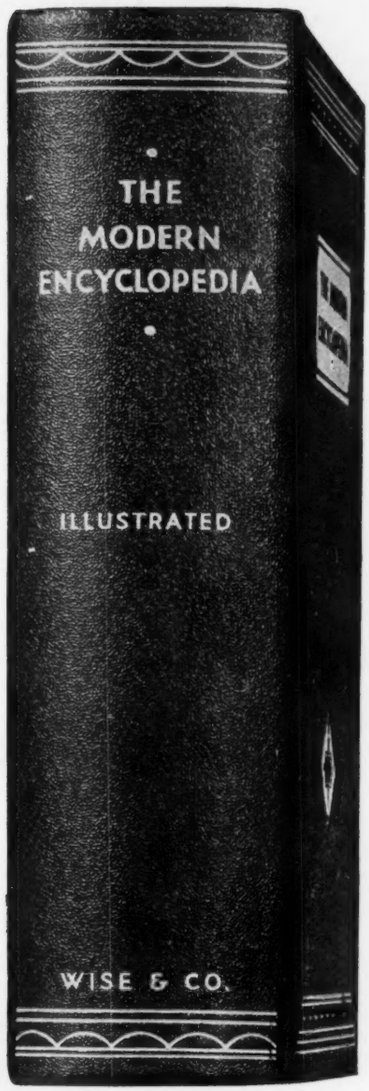
- - and these are only a handful from 22,000 subjects!



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Talking Beacon for Planes . . . 32
Triples Air Beacon Light . . . 38
Paddle Wheels Drive Plane . . 43
Parachute for Plane 45

MODELS

Two New Ship Model Kits . . 8
A Rakish Privateer of 1812 . . 65
High-Speed Transport Plane . . 72
Battle Cruiser *Tuscaloosa* . . 73
Rubber Lessens Railway Noise . 93
Paints Kept in Test Tubes . . 94
Keel for Sailing Model 102
Automatic Crossing Gate . . . 104

NEW PROCESSES AND INVENTIONS

New Glasses Can't Break . . . 20
Comb Comes Apart 20
Repeating Slingshot 20
Device Aids Umpires 22
Organ Played by Light 22
Cast Iron for Paving 22
Gages Voltage From Light . . 23
Television Set Takes Photo . . 23
Cell Prevents Train Wrecks . . 24
New Gun Sprays Stucco . . . 24
Crayon Marks Air Mail . . . 25
Four-Wheeled Bicycle 25
Records Drive Tank 29
Pistol Hammer for Staples . . 32
Suction Cup Uses Lever . . . 32
Locomotive Has Six Engines . . 33
Electric Eye Clocks Horses . . 33
Door Key in Compact 34
Compact Sprays Face Powder . 35
Keeps Flames From Gas Tank . 38
Electricity Makes Music . . . 38
Electric-Eye Mouse Trap . . . 39
Talking Book for Blind 42
Body Motion Runs Bike . . . 44
Canned Rose Bushes 45

PHOTOGRAPHY

Plate-Sunk Photo Mounts . . . 83
Heater for Developer 83
Film Clips from Safety Pins . 83
Soft Light from Photo Bulbs . 92
Labeling Film Storage Cans . . 94
New Use for Printing Frame . 103

RADIO

Numbers Guide Radio Stars . . 22
Radio Set for Hikers 24
Echo Room Adds Realism . . . 43
Radio Kills Insect Pests . . . 48

UNUSUAL FACTS AND IDEAS

Ice from Ocean's Heat 20
Big Propellers for Super-Liner . 21
Odd Sprinkler for Window Boxes 21
Smallest Electric Furnace . . . 24
Lightning Leaves Photo 24
Fountain Pens From Feathers . 25
Revolving Hat Displays Ads . . 25
Heater Keeps Fish Warm . . . 34
Oldest "Corn" Baked Clay . . 34
Tool Making Inventor's Hobby . 34
Find Bones of Florida Giant . . 35
Wind Tunnel for Skyscrapers . 35
Hidden Lamps for Garden . . . 38
Big Speakers Report Game . . 39
Mail Shot in Rockets 39
Rapid Bean-Pole Setter 39
New War on Vermin 42
Biggest Dredge Pans Gold . . . 42
Moths Raised in Laboratory . . 42
Call System Uses Code 43
Armadillos Bred on Ranch . . 44
Odd Craft Raises Subs 44
Mirror Frame for Trick Photo . 44
Giant Sprinkler Waters Farm . 45
Tricks for Home Magician . . 53

FOR THE HOME OWNER

Making Rugs Slip-Proof . . . 78
Concealing Holes in Furniture . 81
Carrier for Raked-Up Leaves . 84
Dry-Cleaning Gloves 85
Stand Holds Cookbook Open . 93
Fixing Loose Wood Screws . . 97
Silencing an Electric Clock . . 99
Kindling Camp Fires 106
Homemade Sweeping Compound . 113
Improvised Long Envelope . . 119

IDEAS FOR THE HANDY MAN

Homeworkshop Guild News . . 68
New Auto-Driving Game . . . 69
Combination Aquarium-Bookcase 70
Jig-Sawed Dragon Bracket . . . 78
Cover for Babbitt Ladle . . . 80
Stopping an Oil Leak 80
Repairing Commutators . . . 80
Turning Wooden Dowels . . . 81
Adapter for Jig-Saw Blades . . 81
Shims from Cigarette Wrappings 82
Table Lamp Shaped Like Tree . 84
Squaring a Rip Gage 85
Toys from Coffee Cans 85
Durable Tile-Top Tables . . . 86
Home Workshop Blueprints . . 88
Inlaying Names in Wood . . . 89
Quick-Action Pin Vise 89
Tube for a Telescope 89
Laying Out a Workshop . . . 90
Old Bill Says— 91
Clock Cases from Waste Wood . 92
Glaziers' Points Hold Pictures . 92
Putty Mixed as Needed . . . 93
Holder for Soldering Flux . . 94
Thread Template Saves Time . 94
Angle Plate Fits in Cabinet . . 96
Special Reamer Stock 96
Preserving Hardware Labels . . 97
Quick Way to Tie Square Knots 97
"French Polish" for Turnings . . 99
Tap Drivers Easily Made . . . 103
Artificial Marble Vases 105
Tape Helps Apply Solder . . . 106
Jig Saw Notches Paper 106
Leather-Covered Cigarette Jar . 113
Playground Ball From Tire Tube 115
Universal Joint for Telescope . 115
Annealing Hack-Saw Blades . . 115
Lining Up Small Punches . . . 119
Homemade Cutting Oil 119

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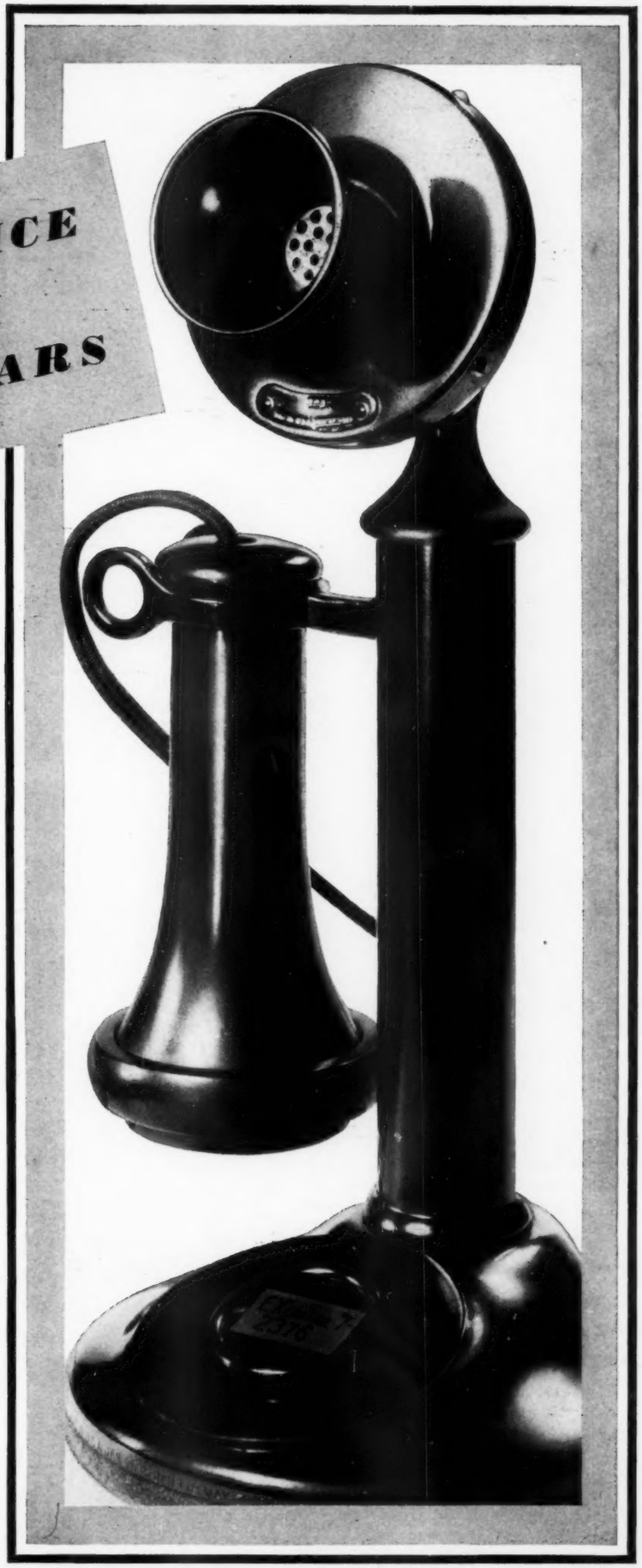


THROUGH recent trying years there has been no letting down in the quality of your Bell telephone service. On the contrary, improvement has gone steadily on.

On long distance and toll calls, the percentage of calls completed is now higher than ever before. The average time required for making these connections has been reduced from 2.8 minutes in 1929 to 1.5 minutes. Since 1929, mistakes by operators have been reduced one-third and more than 99% of all telephone calls are now handled without error.

The number of service complaints by customers is now the lowest on record and reports of trouble with instruments have decreased 17% since 1929. It is truer than ever that this country enjoys the best telephone service in the world.

The ability of the telephone system to improve its service in difficult years is due to unified management and a plan of operation that has been developed and perfected over the past half-century. In good times and bad, it has proved the wisdom of one policy, one system and universal service.

BELL TELEPHONE SYSTEM

SIMONIZ

Stops

"Finish Rot"

FROM DESTROYING YOUR CAR'S BEAUTY

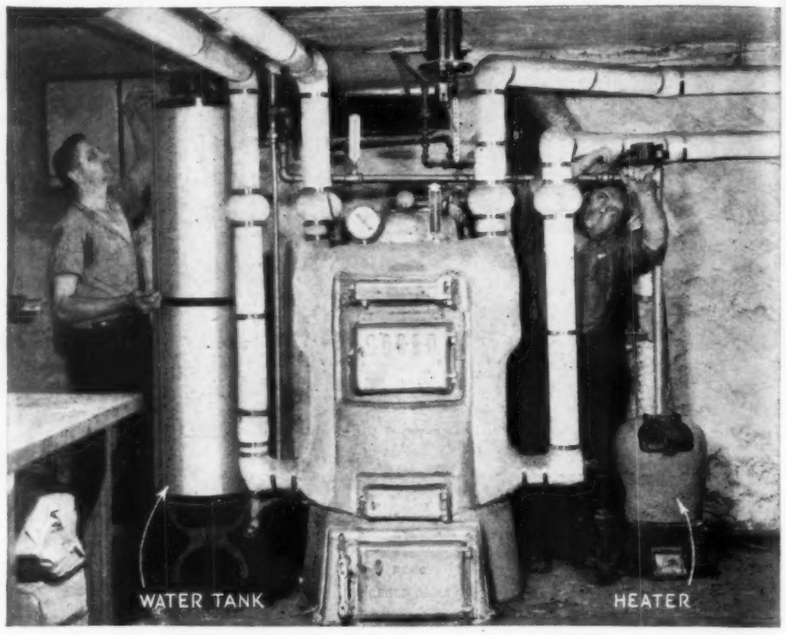
Every car needs Simoniz to guard its beauty from "finish rot"... decay caused by weather, dirt and ultra-violet rays that destroys the finish.

SIMONIZ Keeps Cars Beautiful for Years

Play safe and Simoniz your car! Then weather and dirt can't ruin the finish. Simoniz positively stops them! It makes the finish last longer and keeps colors from fading.

You'll be surprised how easy it is to make your car sparkle like new with the wonderful Simoniz Kleener. Then apply the world-famous Simoniz, and the finish will stay beautiful. Insist on Simoniz and Simoniz Kleener for your car. Nothing takes their place, so avoid substitutes.

MOTORISTS WISE SIMONIZ



This inexpensive "bucket-a-day" hot-water heater, with a suitable tank, supplies hot water for an average home for less than seven cents a day

Improving your Heating System

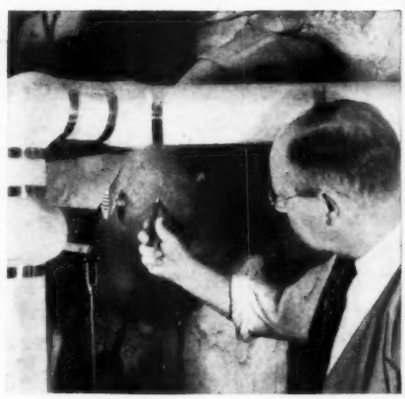
By R. M. BOLEN
Secretary, Popular Science Institute

FEW home owners would knowingly pass up an opportunity to save ten dollars or more on their yearly heating bill. Yet fully ten per cent of the coal shoveled into the average soot-coated furnace is literally wasted.

Besides reducing the force of the draft, soot is an effective heat insulator. A layer only one thirty-second of an inch thick on the walls of a water boiler or hot-air chamber will waste one shovelful of coal in every ten, while a three-sixteenths-inch coating may skyrocket your losses to more than sixty per cent.

If, like most home owners, you simply allowed your fire to die last spring and have thought no more about it, fall offers you another opportunity to clean your furnace and prepare for an economical winter. True, the work may be dirty, but then a five- or ten-dollar saving in fuel is ample pay for the half day that the job will take you.

Because it is the flimsiest part of any furnace and the one dangerous point that may cause serious trouble, the smoke pipe forms a fine starting point for your cleaning operations. Brush it out thoroughly and inspect it carefully for leaks and weak spots. If it has been in use for several years, it will probably need replacing. The cost of a new smoke pipe is negligible; lengths and elbows can be obtained for from twenty-five to fifty cents, depending on the size of the pipe.



An annual inspection of your furnace smoke pipe is good safety insurance. This pipe appeared to be in good shape, but it took only the slightest pressure to force the end of a pencil through it

Once the smoke pipe has been replaced and carefully joined to the furnace and chimney, you can turn to the flues and inner walls of your furnace. Almost any stiff-bristled brush can be used for cleaning the soot from these surfaces, but you will save time by investing in a regular wire flue brush. Jointed metal flue scrapers also available will prove a valuable aid.

In so far as soot cleaning is concerned, your work will be the same regardless of the type of furnace. Steam-heating plants, hot-water boilers, and hot-air furnaces all have their heating surfaces which must be cleaned if you are to get the most from your coal.

If your system is of the steam or hot-water type, you will have another source of heat loss to combat—the sediment and rust that collect in your boiler. Like soot, this also is an excellent heat insulator and accounts for large amounts of wasted heat. In a steam system, it can usually be removed by draining and flushing the steam boiler. Repeat the process until the water from the drain cock at the base of the furnace runs relatively clear.

In draining a hot-water system, remember that the air vents at each radiator must be opened to release the vacuum and allow the water to flow into the boiler and out of the drain cock. To refill, turn off the drain cock, open the water supply valve, and then close each radiator air vent as the water appears. When the entire system has been filled, check the expansion tank to make sure that it contains water before shutting off the main supply valve.

IF YOU find that your hot-water or steam boiler has developed a small leak, it does not necessarily mean that you must call in a professional plumber. An excellent repair sometimes can be made by employing a mixture of ordinary bran and corn meal.

The water in the boiler should be warm. On a steam boiler, remove the safety valve and, after making sure that the water level is within about two or three inches of the valve opening, pour in your mixture of bran and corn meal, using about one quart of bran to one pint of meal.

Replace the safety valve and build up the fire. Allow the water to boil for at least thirty or forty minutes and, after waiting for the fire to die down, again remove the safety valve. Next, drain a bucket of water from the outlet valve, pour it into the safety valve opening, replace the valve, and again build up the fire. This cyle should be repeated three or four times.

In the case of a leaking hot-water boiler, the same procedure can be followed with the exception that the thermometer instead of the safety valve must be removed to admit the bran and corn meal. Also, it will be necessary, before starting operations, to drain enough water from the entire system to bring the level down to approximately two inches below the thermometer opening.

In either case, allow the fire to subside for about a half day before finally building it up again to the maximum point and filling the system to the proper level.

IF THE glass water gage on a steam boiler has become so coated with rust and scum that it is difficult to see the water level, it can be cleaned in the following way: Procure a small amount of muriatic acid and place about a teaspoonful in a tea cup of hot water. Then, when the system has developed several pounds of steam, close both valves (top and bottom) on the gage, open the petcock at the bottom, and then reopen the top gage valve slightly.

When steam issues from the petcock, close the upper valve and immerse the lower end of the petcock in the solution. Open the top valve, allow the steam to bubble through *(Continued on page 10)*

"Let's Run Away, Then!"

(A STORY FROM LIFE)

PETER AND DONNIE were pitifully small to be left alone in their western home after the death of their parents. That's why their Uncle Ed sent for them to live with him.

But Uncle Ed was away on business most of the time, and it was his high strung wife, Eva, who had to care for them. Everything they did annoyed her. Their childish laughter and healthy fun disturbed her. She nagged and scolded. Often she whipped them... Only Grandpa, who boarded with Uncle Ed, really loved them.

Sometimes in the dead of night they planned desperately to run away—anywhere. Anything to be free! But always Grandpa's love made such desertion seem treason.

Then one day, when things seemed darkest, Grandpa sprang a surprise.

"Peter and Donnie won't bother you any more, Eva," he said. "We three are going away together. You see, my Provident Mutual retirement policy matures today, and every month as long as I live I'll get a check for $150. Get your things ready, boys. We're going home!"

* * *

On nine successive Tuesday nights, starting October 2 with the story of Peter and Donnie, Provident Mutual will broadcast a series of stories from life over the NBC Blue (WJZ) network.* Tune in the *Story Behind The Claim* and enjoy the real drama behind this "business of a million thrills."

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But you must get the right kind of mackerel fillets—the pick of the new Fall catch is what you want—to get this real food joy. That's the secret of the tempting goodness of my mackerel fillets. I send you the choicest fillets that are carefully sliced from the fat, tender sides of the new Fall-caught mackerel. Practically boneless, no waste parts whatever, these mackerel fillets are so tender and full bodied that they just flake into juicy mouthfuls.

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unless you wish to

Just send the coupon below or write me a letter, and I'll ship you a pail of 18 small tenderloin mackerel fillets—each fillet suitable for an individual serving. My fillets come to you all cleaned—no heads—no tails—no large body bones—no waste whatever—just meaty fillets packed in new brine in a wax-lined wooden pail. Taste one—broiled the Down East way. If not satisfied it's the finest mackerel you ever tasted, return the balance at my expense. Otherwise, send me only $2 within 10 days. 200,000 families get their seafood from me this "prove-it-yourself" way. I've been doing business this way for 49 years and I must say that this is the lowest price for this size pail of mackerel fillets I've ever offered. Send your coupon today for this real Gloucester treat.

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My dear Mr. Davis: Please send me, all charges prepaid, a pail containing 18 small, tender mackerel fillets, clear fish, no heads, tails, or waste parts, and practically boneless. If, after trying a few fillets, I am not entirely satisfied, I will return the rest at your expense and will owe you nothing. Otherwise, I'll send you $2.00 within 10 days.*

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*If you wish to send check for full amount now, I'll include with your mackerel a copy of my 25c beautifully illustrated cook book containing 136 delightful seafood recipes. Your money will be instantly refunded if you are not pleased in every way.

This Month We Offer Two New Ship Model Kits

FOR BUILDING THE
Privateer *Swallow* and the
U. S. Cruiser *Tuscaloosa*

KIT Q

KIT R—Materials for U.S.S. *Tuscaloosa*

THIS is the time of year to start your ship model making in earnest. For that reason we have prepared two new construction kits containing all the materials for making our latest models, the privateer *Swallow* and the 10,000-ton U. S. cruiser *Tuscaloosa*.

The *Swallow* is a scale model of the finest type, and has the advantage of being relatively small—20 in. long and 13½ in. high over all. It is such a graceful little ship, and the model is so perfect in all details, that the most experienced model makers will find it a thoroughly satisfying project, yet it is not too complicated for craftsmen of limited experience. The kit contains the four hull pieces or "lifts" sawed to shape; hardwood for making the stem, stern, rudder, keel, bulwarks, and other small parts; round stock for the masts, spars, and guns; material for the blocks; celluloid for the caps and deadeyes; sheet brass, two sizes of chain, brass tubing, three coils of wire, four coils of the best rigging cord, three bottles of enamel, one bottle each of stain and varnish, glue, and all other essentials. With three sheets of blueprints, which are alone worth 75 cents, the kit is priced at only $4.95, postpaid anywhere east of the Mississippi River.

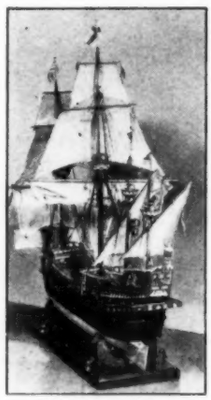
The *Tuscaloosa* kits were prepared especially for the Popular Science Model - of - the - Month Club, but a large enough supply has been made up for other readers who may wish to build this remarkable little balsa-wood model. It is important, however, to send in your order promptly. The price of the kit, with a blueprint containing full-size drawings and complete instructions, is only $1, postpaid. The finished model is 11¾ in. long, and the same highly simplified method of construction is used as in previous Model-of-the-Month kits.

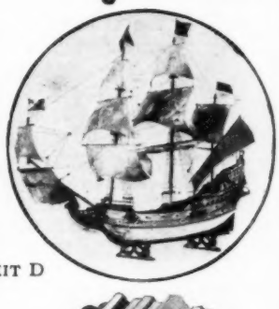
All our kits are given on the following page. The standard ship model kits and the Model-of-the-Month kits contain only the raw materials, but the simplified ship model kits contain some finished and semifinished parts. The furniture kits are completely machined and practically ready to assemble. Blueprints or instructions accompany all kits.

Each of the Model-of-the-Month kits contains an application blank with which to obtain a free membership in the club.

NO. 5

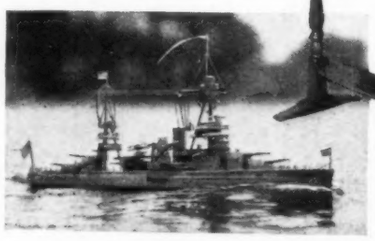
NO. 6





KIT D

KIT G



NO. 4

KIT E

NO. 2

KIT L

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer*, 20½-in...$6.90*
AA. Same with hull lifts sawed.....7.40*
D. Spanish galleon, 24-in..... 6.45*
DD. Same with hull blocks shaped..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 6.95*
EE. Same with hull lifts sawed..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 6.75*
GG. Same with hull blocks shaped..... 7.25*
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33½-in. hull..... 7.95*
LL. Same with hull lifts sawed..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape..... 4.95*

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in... .75
O. Liner S. S. *St. Louis*, 11-in..... 1.00
P. Cup yacht *Rainbow*, 7½-in..... .75
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in... 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

FURNITURE KITS

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40*
No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*
No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*
No. 6. Solid rock maple butterfly table, top 19 to 22 in., height 22½ in. Ready to assemble and stain included..... 6.90*

VENEERING MATERIALS

No. 7. Veneering kit with selected veneers, crossbanding material, inlays, tape, glue, veneer saw, and book of instructions, for veneering a coffee table, serving tray, mirror frame, book-rack, and jewel box..... 7.75*

NOTE: If you live west of the Mississippi River, add 50 cents to all prices marked with an asterisk (*) because of the heavy shipping charges. Otherwise all prices are postpaid anywhere in the United States. The kits marked with an asterisk will be sent C. O. D. upon request, but the purchaser will have to pay 28 cents additional upon delivery.

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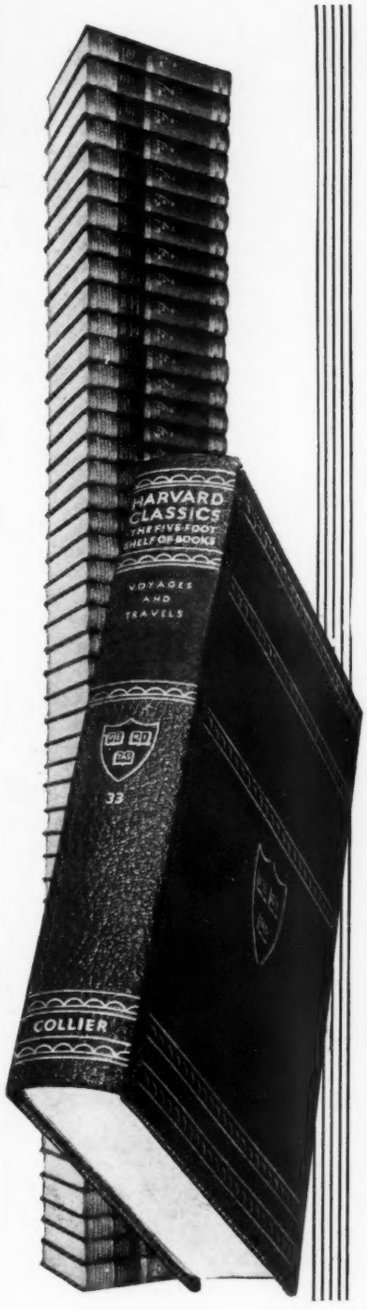
How to get rid of an INFERIORITY COMPLEX



A true story of a man who found that self-confidence is not a matter of education or luck

HE WAS GOOD in his job. No one denied that. But he felt inferior to his associates. Most of them were college men. He envied them the mysterious thing called "background."

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HOW TO IMPROVE YOUR HEATING SYSTEM

(Continued from page 7)

the liquid for several seconds, and finally reclose it, leaving the petcock immersed in the acid solution. The condensing steam will create a vacuum in the gage tube and cause the solution to be drawn up. By repeating the process several times, every trace of discoloration can be removed. Don't forget, however, that when the job is completed, the petcock should be closed and the two steam valves open.

FIVE or ten minutes spent in checking over the controls on your furnace will not be amiss. Try the drafts to be sure they are in working order and apply a small amount of machine oil to the moving parts of the various regulators. See that all flue, ash-pit, and fire-box doors close tightly and have not been rusted by the moist air of a humid summer.

Although with the coming of winter and the starting up of the furnace, the problem of a hot water supply in most cases will be solved, it is a good time to plan and install an economical auxiliary hot water heating system for use next spring. The system illustrated on the preceding page, costing less than sixty dollars completely installed by professional plumbers, consists of a so-called "bucket-a-day" coal heater and a generous supply tank. This arrangement has supplied enough hot water for a three-bathroom house at a cost of less than seven cents a day.

If the home owner has time, he can install such a system himself and thereby reduce the initial expense by the cost of the labor involved. Bucket-a-day heaters can be obtained for from seven to seventeen dollars, depending on the size, and supply tanks sell from six or seven dollars up depending on the construction and the quality and type of metal used. The pipe and pipe fittings should not run more than eight dollars at the most.

ANOTHER economical solution to the hot water problem is the oil-burning hot water heater. Available in low-priced units either of the manually operated or automatic type, these systems offer low cost hot water with a minimum of dirt and bother. In the automatic form, a sensitive thermostat insures a good supply of hot water at all times without any form of manual control except an occasional check on the oil supply.

The fall is also a good time to plan for additional radiators in an attic room, sun porch, or garage. Remember, however, your heating plant must be large enough to take care of the increase in heating area if you are to obtain good results. Your plumber or heating expert will be glad to advise you.

A good solution to the problem of heating an inclosed porch or an extra room without altering your present heating system can be found in the new unit type oil heaters recently placed on the market.

Remember, it is much easier to make additions and repairs to a heating system before the furnace is pressed into use. Once the cold weather sets in, there will be little time to shut down for cleaning or adjustment.

"FOR HOURS, DOC, SHE'S ONLY SAID 'PHEW!'"

HER husband feared it was an attack of her old asthma, but the eminent M. D. correctly diagnosed the trouble as "Gas-ma"—overpowering smoke-clouds from a long-neglected pipe and grouchy tobacco. The best tobacco in the world is unhappy in an unclean pipe, and hubby's was far from the best.

Clean out the old pipe, friend. Pack it with Sir Walter Raleigh Smoking Tobacco. Then puff away and watch your Sweet Mama smile again. Sir Walter Raleigh has a mildness that wins you, and a delicate fragrance that wins others. Sales of this choice Kentucky Burley blend have boomed because it really *has* the mildness mankind is searching for. Try a tin ...will ya, man?

Brown & Williamson Tobacco Corporation
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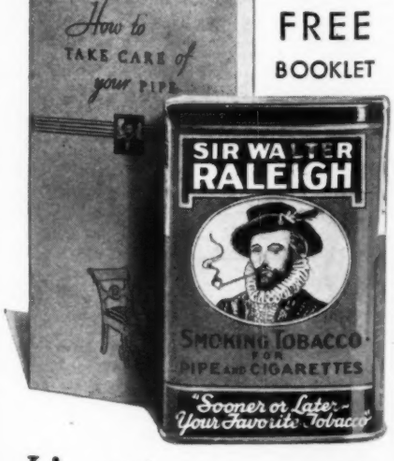
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Celluloid	Hair Setting	Porcelain
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Decolorizing	Insulation	Safety Glass
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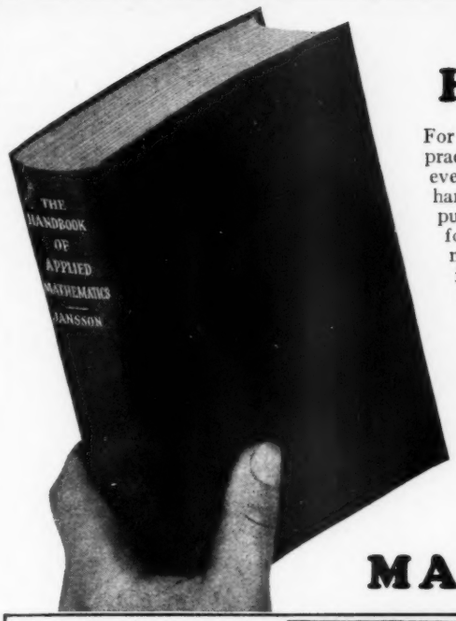

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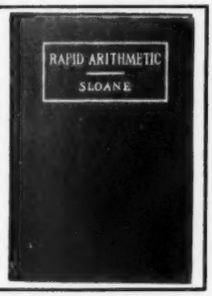

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Our Readers Say

A Stereoscope Goes With Every Copy

WHILE looking at POPULAR SCIENCE MONTHLY the other day, I was struck suddenly by an idea. Why not have perspective pictures in your magazine? I mean pictures that possess lifelike depth. This could be accomplished by printing the picture and then printing a red line next to a blue line around the edge of everything in the picture. Then supply a pair of cardboard spectacles with a piece of red gelatin in one eyepiece and a piece of blue gelatin in the other. It would give a much clearer impression of the new scientific gadgets, and a better idea what they look like, than the usual flat photograph. Of course, this would raise the price of each issue, but I would gladly pay it. I wonder what your other readers think?—J.J.E., Newark, N. J.

There May Be a Meteor at the Bottom of It

THE article about meteors by F. C. Cross (P.S.M., Aug., '34, p. 32) was especially interesting to me on account of an experience I had a few years ago. On San Juan Mountain in Colorado a friend showed me a mysterious cave on the ridge that divides the counties of La Plata and Archuleta. The cave is about ten feet in diameter, almost perfectly round, and goes into the ground at an angle of about forty-five degrees. When you drop a stone into it, you can hear the noise for several minutes. One fellow was brave enough to descend into the cave and explore it, but his party would not let him take the risk. I don't say that this cave was made by a meteor, but I believe that scientists will some day discover some interesting facts about it. I wonder whether any of your other readers happen to be acquainted with this remarkable cave.—L.B.M., Radnor, Pa.

Speak of the Devil and He Appears

I HAD just finished reading the article "Hunting Fireballs That Fall to Earth" (P.S.M., Aug. '34, p. 32) and was talking to a friend when I looked up just in time to see a fireball go across the sky. The time of this incident was 9:55 p.m., E.S.T., on July 24. The fireball's apparent size was about that of the planet Venus, and the trail was of a fiery orange color. I did not hear any noise, though the fireball burned for two seconds before it faded into the darkness and disappeared.—M.J.R., Cleveland, Ohio.

This "Faithful Ham" Wants An All-electric Receiver

I HAVE followed your radio features for the past year as faithfully as any "ham" possibly could, but I have not yet found what I'd like to see. Of course, I realize that you can't please everyone and I must admit that you have had some very hot numbers, but just in case you find a circuit diagram for a two-tube, all-electric midget like those that have just been put on the market, will you please chase it out our way? I know a lot of your readers would welcome this as a pleasant change from battery-operated receivers. I ought to have plenty of support in asking for an all-electric midget.—J.M., Wapakoneta, Ohio.

Two Witnesses Testify That Snakes Swallow Their Young

IN THE Here's the Answer department of your August issue you have a question about snakes swallowing their young to protect them, and you say that experts have found nothing to prove that this really happens. About forty years ago I was hunting on the Ouachita River about four miles below this town when I came upon a fairly good-sized snake, of the land-moccasin genus, I believe. Not wishing to waste a shell on it, I killed it with a stick. When the snake was pretty well disabled, I was surprised to see six small snakes, about eight inches long, crawl from the large snake's mouth. I have killed many snakes before and since that time and this is the only instance of the kind that has ever come under my observation, but it is sufficient to prove to me that some kinds of snakes do carry their young.—W.P.A., Arkadelphia, Ark.

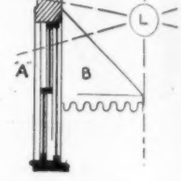
I HAVE seen a mother snake, wounded by a hay-maker's scythe, swallow several of her young to protect them. It was many years ago, but I have a very distinct memory of coming upon the scene where the mower was watching the proceedings. He killed the mother, extended the gash the scythe had made, and liberated the young ones. This happened on my father's farm in this town more than seventy years ago.—Mrs. J.H.C., Bakersfield, Vt.

This Reader Wants More Electrical Experiments

I SHOULD like to ask, in Our Readers Say, how many other readers would enjoy a series of articles on electrical experiments, such as have appeared individually from time to time. I have in mind particularly the articles on Black Light (P.S.M., Dec. '32, p. 75) and on Neon Experiments (P.S.M., July '34, p. 75). Many of your readers are, no doubt, curious about the fundamentals of electricity, and an explanation of the how and why of transformers, induction coils, electromagnets, arcs, sparks, and so forth, seems to me to be very much in order.—I.B., Utica, N.Y.

Now You See 'Em And Now You Don't

HERE is a problem that may be of interest to your readers: The building "A" with awning "B" is about 110 feet from the observer's eye. The electric light "L" is about 450 feet away. At night, when the light is shining brightly, two of the six rays show across the building "A" and the awning "B" when viewed through a mosquito screen. When you look at them through window glass no rays are shown. I have no explanation to make; I merely state facts. There are in both cases innumerable small rays that show, faintly.—E.P.N., Richmond Hill, N.Y.



A Few Questions About the Why, Whence, and Whither

SOMEONE answer this, if you can: I have heard that the end of space is about two billion miles from the earth. I don't see how this could be, for if at the end of space there is nothing, then there must be still more space; and if at the end of space there is something, then it must occupy the endless space beyond. Here are some more things that have been bothering me: Where does sound go? When did time begin and how will it end, if it does? For what purpose are the sun and its planets being drawn toward the star Vega? What's on the opposite side of the moon—the side that man has never seen? If you can get me definite answers to these questions, I will have nothing to keep me awake nights.—R.F.F., Los Angeles, Calif.

Windmill Generator Charged with Overproduction

I AM very much pleased to see the one-tube radio sets in POPULAR SCIENCE MONTHLY. Keep up the good work and give us amateurs a break. The wind-driven battery charger described in the August, 1933, issue has been a great help to us here on the farm. Our radio battery is always charged and we have electric light in the basement. Now that we have so much electricity to throw around, why not give us an electric motor run by a six-volt battery? It's O.K. for the city fellows who have power lathes, jig saws and drills, but here in Western Canada we're not hooked

up with that yet. I hope you will give this some consideration. I like everything in the magazine, but give us more radio.—J.S., Russell, Manitoba, Canada.

The Park Board Will Have Its Little Joke

I WANT to make a suggestion for the improvement of the portable picnic table described on page 76 of your August issue—that is, to put a cross base under the legs at either end. When the Park Board in this town first put in picnic tables, they made them according to your plan, and this is what happened: while picnickers were using two of the tables in a park, one of the tables became overbalanced by having too many people on one side of it. When one of the company on the light side suddenly got up for something, the table upset and piled picnickers, dishes, dinner, and all into a thoroughly scrambled mess. At the other table, those sitting with their backs to the racket jumped up to see what the excitement was all about. Those facing them sat still and laughed—until their table became overbalanced and did the same thing. There is no telling how far the comedy would have gone if more of the near-by tables had been occupied. Another thing: Someone recently asked for a "skeeter" chaser. Here is the most simple and effective that I have seen yet. The worst mosquitoes that I have encountered in many years were in an auto camp near Portland, Ore., after a warm summer rain late in the afternoon. The mosquitoes were there in full force, heavily armed and ready for business. Some of the other campers had a fly squirt, which was effective for only a few minutes, after which the pests would be back again as bloodthirsty as ever. As a last resort I took a cake of a much advertised and smelly toilet soap, rubbed a little of it on a wet wash cloth and smeared myself thoroughly with it. The resulting odor was not disagreeable to me, but the entire mosquito family packed their tools and left in disgust. This remedy is economical and convenient, since the soap can be carried easily anywhere, and serves a double purpose. —A.H.B., Los Angeles, Calif.

Microscopes Are Too Tame for This Girl Mechanic

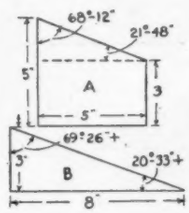
I ENJOY the auto articles about Gus of the Model Garage, and your auto hints, very much. I wish that you would publish more articles on steam, Diesel, and gas engines, omitting the photography, microscopy, model building, and whatever else may not interest an average auto mechanic. I am always anxious to keep up with the times and to be informed as to what the other fellow is doing. Your article about how the police get after the stolen cars was good, and also the one telling how thieves overcome difficulties in stealing cars. I have been subscribing for your magazine ever since I was a little girl and still enjoy it very much. I have always been interested in machinery, and I'd like more articles on this subject. Chemistry and microscopy are all right for some people, but I never cared for them myself. Give me an engine every time.—(Miss) M.D.M., St. Augustine, Fla.

A Magician Pleads for Professional Secrecy

I WISH to protest against the exposure of magic as shown in your articles on the Mechanics of Magic. Being a magician myself, I happen to know the difficulty and cost of making up these tricks. I hope that in the future you will not publish any more articles of this kind.—L.L., Gilman, Conn.

That "Extra Square Inch" Will Cure All Ills

I SEE in your September issue that C.C.B., of Los Angeles, Calif., has solved the age-old problem of getting sixty-five square inches out of sixty-four square inches. I want to say that by this means he has ended all our troubles such as unemployment and finance, and placed the United States back on the gold standard for all time. All that C.C.B. has to do is to take the scheme to the New Dealers in Washington and persuade the Secretary of the Treasury to have all our gold bullion rolled into slabs one inch thick and eight inches square. He would then have the unemployed cut the slabs up as per C.C.B.'s sketch, gaining one cubic inch of gold out of each slab. Since a cubic inch of gold is worth quite a lot of money, we can easily pay off our national debt, balance the budget in 1936 as per schedule, and solve the unemployment problem at the same time. After C.C.B. has found and lopped off the cubic inch of gold, he can send the slab back to the rolling mill and have it put back into the original shape of eight inches square and one inch thick, and continue the process over and over again with great satisfaction to all the taxpayers of the country. Seriously, C.C.B. should have taken his problem to a tool-maker to solve, not to a machinist, millwright, or Einstein. Any tool-maker could have told him that the pieces cut out of the eight-inch square could not be arranged to form a perfect oblong five by thirteen inches. I suggest that C.C.B. take paper and pencil and figure out the angles of these pieces; he will find that the angles are not alike or equal. Take the piece eight by five, which he bisects diagonally as in my sketch. He will find the angle of the cut is twenty-one degrees forty-eight seconds, whereas when he bisects the eight-by-three piece the angle is twenty degrees thirty-three seconds. Therefore, the four pieces cannot be assembled to form a perfect oblong five by thirteen inches.—W.E.N., Erie, Pa.



He Approves of Steam —More Power to It!

How about publishing an article describing the "innards" of some of the old-time steam-driven automobiles? You might tell us readers just why there aren't any more steam-driven automobiles built. Personally, I think steam is a fine source of power.—F.H., Lincoln, Kans.

We'll Be Seein' Ya At the Schoolhouse

BEING a shop teacher in New York City and striving to enrich my professional growth, I am always on the lookout for new shop hints, ideas, and models which my pupils can make and use. I have found that POPULAR SCIENCE MONTHLY has provided me with so many of these hints, ideas, and models that I have becom a constant reader of your magazine. I have not missed an issue since I became engaged in teaching shop work.—F.S.G., Brooklyn, N. Y.

Why Fool with Snakes While the Earth Swallows Itself?

WHEN we have problems of greater importance to consider, I fail to comprehend why D.L., of New Rochelle, N. Y., wastes time over so insignificant a matter as three snakes swallowing each other. To convince himself, all he needs to do is to secure the snakes, starve them for some time, then bait their tails and arrange them in a circle. The exhibition will be brief. Presto, they are gone! We have a similar perpetual performance under us and before our very eyes and rarely ever pay any attention to its unless we are at the place where the results are seen. We should now be fish, or a lower order of life, if that change did not occur. Mountain elevations have crept upwards till the heights were reached. And because the base of the crust as well as the underlying core is rough and irregular, when it goes on a rampage this jars the neighborhood and we say, "An earthquake." If we could go down to the base and smooth and grease the skids, the motion would appear like sliding on skates over smooth ice. There would be the danger of scooting too far and swallowing too much underlying surface. What are your snakes compared to this perpetual performance?—A.S., Dwight, N. D.

A Housewife Puts the Inventors on the Spot

WHY does not someone invent a movable, non-droppable coat hanger with a clamp that holds, yet permits one to change its position on the pole? Why do women endure round spools for thread, when triangular ones would do away with the irritation of having the spool roll to the floor and under the nearest piece of furniture? Why are not ball rollers put on all furniture? Why is any piece of furniture ever made solid to the floor? Why are gas heaters so made that all efforts to sweep under them prove ineffectual? Why does not man accept nature's pattern in the way of curves in the design of furniture? Why do not ironing boards include depressable iron-holders? And why can't rocking-chairs be made without the projecting rockers that are always getting in the way of ankles and shins?—A.L.A., Waxahachie, Tex.

Golfers Would Sneer at this Locker-room Stimulant

A PICTURE on page 20 of your July number set me thinking. It showed a small electric fan used to revive prize fighters between rounds. Why couldn't such a fan be fitted with a little tank of compressed oxygen which would be fed into the air stream? This would increase the amount of oxygen reaching the lungs of the exhausted man and bring about quick recovery. By installing such an oxygen fan in locker rooms and gymnasiums, football players and track athletes, as well as others, could be given new pep in contests.—N.T., Indianapolis, Ind.

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"You can't get by without shaving." Your wife—your girl—your associates may not tell you this. But that's what they probably *think* when your face is marred by stubble. For bristles are repulsive to everyone, men and women alike. So how can any man afford to risk the good opinion of others by failing to shave often and well!

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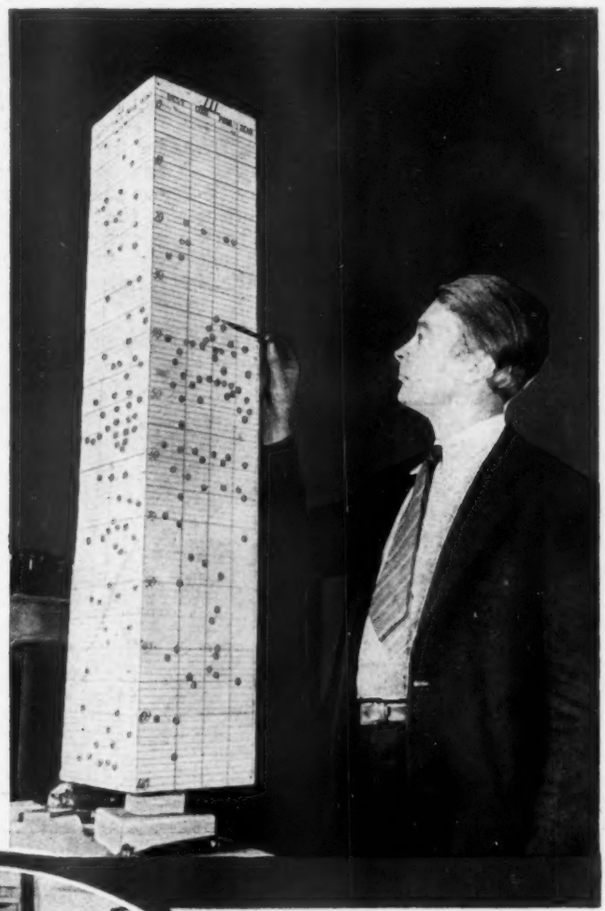
POPULAR SCIENCE Monthly

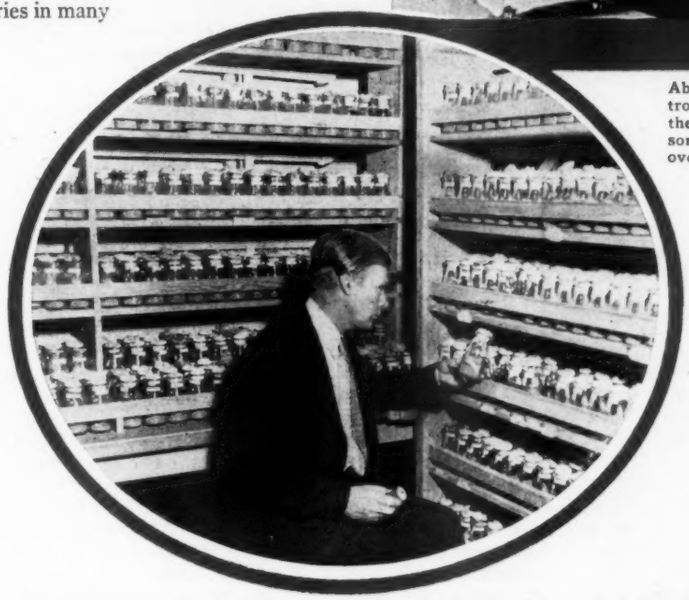
NOVEMBER 1934 VOL. 125 No. 5

RAYMOND J. BROWN, Editor

Sensational Study of HEREDITY *May Produce* New Race of Men

By STERLING GLEASON





Above, life chart of heredity-controlling genes. The black dots show the position of genes in a chromosome. At left, stock room filled to overflowing with experimental flies

BLACK light, heat, and X-rays are being used by experimenters in sensational efforts to solve the mysteries of heredity. Workers in a score of laboratories in many different countries are delving for secrets locked in the living animal cell.

From their discoveries may emerge a new human race, stronger, more intelligent, and better able to resist disease. As the first step, they have produced an amazing chart by which the character of generations of flies yet unborn can be accurately foretold.

Radiations, the newest and most powerful tool of the physical sciences, are chief instruments in this biological study. Lightlike ether waves penetrate animal cells in the search for an M-ray that is asserted to control growth and death. Mysterious emanations of the human body, with the strange power to kill yeast, are being analyzed and compared with the flashes of energy given off when living cells are active or divide. Artificial races, laboratory-produced, grow for generations in the refrigerator while experimenters apply radiation from vacuum tubes or chemicals to produce types of life hitherto unknown.

In a pair of narrow-mouthed glass flasks, Dr. Calvin Bridges, an associate of Dr. Morgan famous cytologist, at California Institute of Technology, recently held in bottles two swarms of tiny gnat-like flies. From each flask he emptied hundreds of flies into small glass chambers filled with ether vapors. Succumbing instantly, the insects became motionless and were then poured out upon a gleaming white plate under the binocular microscope. Virgin females from one race and males from the other were selected for the start of a spectacular experiment.

Into a tiny quartz tube Dr. Bridges put the males, then took them to the Kellogg Radiation Laboratory which houses the three-story X-ray tube producing the most penetrating rays ever controlled by man.

A low hum arose as giant oil-immersed transformers went in-

to operation in the laboratory. A sharp hissing sound came faintly through concrete and lead walls as a million-volt flame of electricity crashed across spark gaps. A stream of invisible X-rays was being reflected from a target hidden in the cylinder of the tube which passed through the exposure room from floor to ceiling.

Three seconds later, Dr. Bridges removed the X-rayed insects from their searing bath and placed them together in a flask containing a little agar, molasses, and yeast.

Within ten days, a new generation of the flies had been born. What mysterious rearrangement of the life-controlling elements, or genes, had been wrought by the influence of the X-rays? Placing the anesthetized insects under the microscope, Dr. Bridges sought the answer.

Striking abnormalities were at once apparent. The eyes of one male were bright vermilion instead of the normal dull brick red. The wings of another stood out stiffly at an angle from the body instead of folding back neatly along its sides. Still another had an extra pair of wings which no normal fly should have.

Into glass homes went the freak flies, to breed new generations of their kind. The results of these experiments were recorded by sticking push-pins with lettered heads into a tall, four-sided post, marked off by horizontal divisions. More knowledge had been added to the famous life-chart which graphically depicts how this species produces new kinds in bewildering variety.

In thick-walled vaults at California Institute of Technology, more than 700 distinct races of the tiny fly, known as Drosophila, live in refrigeratorlike vaults and

In this laboratory, flies are etherized and then placed on a white plate and examined under a high-powered lens

Four kinds of chromosomes found in fly Drosophila are shown in these wooden models. The genes are invisible lying along the edges of chromosomes

reproduce their kind for the benefit of science. The insects go through their life cycle at the rate of three generators a month, thirty-six a year. Many of them have a recorded family tree which, if they were men instead of flies, would date back 15,000 years before Adam.

For forty years, scientists have known that characteristics are inherited according to a definite plan. But no one understood why freaks, unlike any known ancestor, sometimes occur. For example, there was a short-legged lamb which in the eighteenth century suddenly appeared in the flock of Seth Wright, a New England farmer, and was reared by him to produce the Ancon breed of sheep, favored because they are so short-legged they can not jump over an ordinary stone wall.

It was also known that the body contained two kinds of cells—body cells, and reproductive cells, the latter being the only link between one generation and the next. All cells multiply by division. In a growing child, each cell is believed to split at least once a day, producing millions in a month, billions in a year. But what mysterious change goes on in the reproductive cell to produce freaks, or "mutations"?

Dr. Morgan undertook to find out, using the tiny yeast fly as guinea pig. One day he made the exciting discovery that one of his flies had snow-white eyes instead of the normal brick-red. He bred the fly to produce a race of white-eyed flies and found the trait to be "sex-linked"; that is, it followed sex. Only the males of a particular generation had white eyes. Females were normal. Soon other sex-linked traits, as yellow body-color and miniature wings, appeared.

Why did these characteristics follow sex? Dr. Morgan said that whatever element in the germ cell determined sex also must contain something which caused the "mutations."

Under the microscope the scientist could see the four pairs of rodlike chromosomes, like tiny punctuation marks. Chromosomes had already been studied intently for several decades without definite knowledge of their function. Experimenters knew them only "stainable bodies" in the central portion or nucleus of each cell. But now—Morgan was saying that one particular chromosome, which was different in males and females, must contain the genes which cause white eyes and other sex-linked characteristics, as well as sex itself.

His colleague, Dr. Bridges, soon discovered that certain freak flies with strange

Below is one of the specially designed culture bottles used in raising pedigreed strains of experimental flies. These flies are so small that 500,000 of them will weigh only a pound

sex characteristics—flies half male, half female—were seen to have new configuration in their chromosomes. Certain freaks were remarkable in that no part of the fly was left unchanged. Bridges found that such flies had suffered accidents resulting in broken chromosomes, the loss of a whole section of chromosomes, or sometimes the gain of an extra piece. Thus he proved that the genes which produced the characteristics are actually parts of the chromosomes.

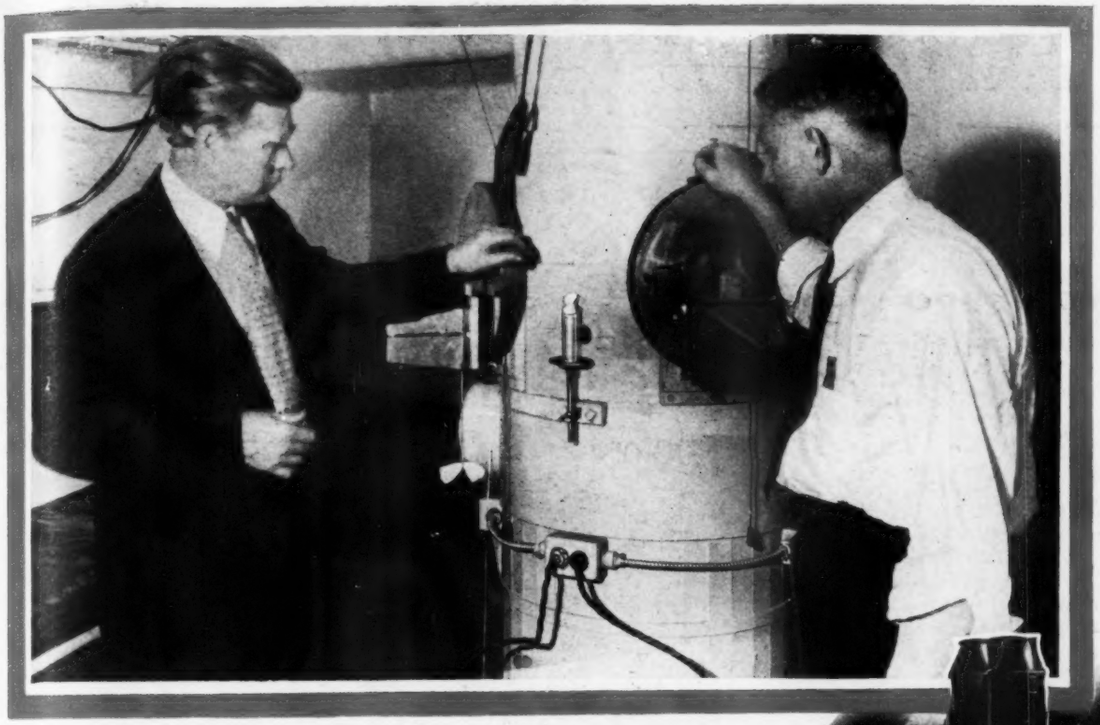
So tiny are the chromosomes that even under the most powerful of microscopes, they can be seen only indistinctly. Then came the startling discovery that in the salivary glands of the Drosophila larva, chromosomes grew to be sixty to seventy times bigger than ordinary. In these giant cells, experimenters could see the four pairs of rods with great detail. Their banded structures were clearly visible and the point at which the chromosomes had broken and recombined could now be accurately plotted on the life-map.

Years of research showed that each part of each chromosome contained specific character determiners. Each controls the development of one characteristic of the fly. Thus the genes which Morgan had suspected, actually exist as minute groupings of the chromosome material itself.

Further research has now given the world a strange life-chart. Each side of the square post on which it is built represents one of the four chromosomes. Each button with which it is studded represents a gene, controlling some physical characteristic of the fly. The experimenter can read directly upon the map what proportion of grandchildren will show any given combination of traits.

This actual mapping of the microscopic

X-Rays and Invisible Light Reveal Life Secrets in Germ Cell



In the new study of heredity, flies are exposed to the powerful X-rays from a million-volt tube. This picture shows the first step in radiation treatment in the Kellogg Radiation Laboratory

chromosomes created a sensation among scientists. In thirty or more laboratories all over the world, more than a hundred workers are spending their time in filling in blank spaces of the life-chart. Twice a year a special bulletin is issued by Drs. Bridges and Demerec as an international clearing house for information.

Even with the rapidly growing Drosophila, experimenters might have worked for years without finding more than a few of the freak types which permit them to find the genes had it not been for X-rays. Nature produces few freaks, perhaps one in several thousand generations. But under bombardment with X-rays, mysterious changes occur in the germ cells. Chromosomes are shattered and recombined in new patterns producing freak flies at 150 times the normal rate.

WHY do body cells suddenly begin to run riot and multiply at an extraordinary rate, producing the mysterious disease known as cancer? In the chromosome of the mouse, Dr. Maud Slye, of the University of Chicago, has sought the answer, carrying her researches into the living germ cell of the little rodent in much the same way that Drs. Morgan and Bridges have probed the germ-cell of Drosophila. She has found that mice can inherit a susceptibility to cancer. For twenty-four years she has bred the animals for study, beginning with a pair mated in 1910. On the laboratory operating table, she has performed more than 116,000 mouse autopsies. Breeding tests have enabled her to narrow the source of the strange liability to cancer, to a single gene located in a chromosome of the mouse. Another gene, she discovered, has the power, if inherited, to protect its possessor against the disease.

Other experiments, revealing the effect of rays on plant life have produced results almost as spectacular as those conducted upon insects and animals. Magicians of the laboratory have altered the characters of plants, changed their time of blooming and produced new varieties by exposing them to the bombardment of invisible rays.

A few years ago, Dr. L. J. Stadler, of the Missouri College of Agriculture, employed a curious portable X-ray machine to study the effect of the rays upon growing corn. Pushed up and down the rows like a hand cultivator, the apparatus bathed each stalk with X-rays before it passed on. As a result, Dr. Stadler found curious alterations took place in the growing plants. Through his researches, he hopes to develop new and better varieties of corn and other grains.

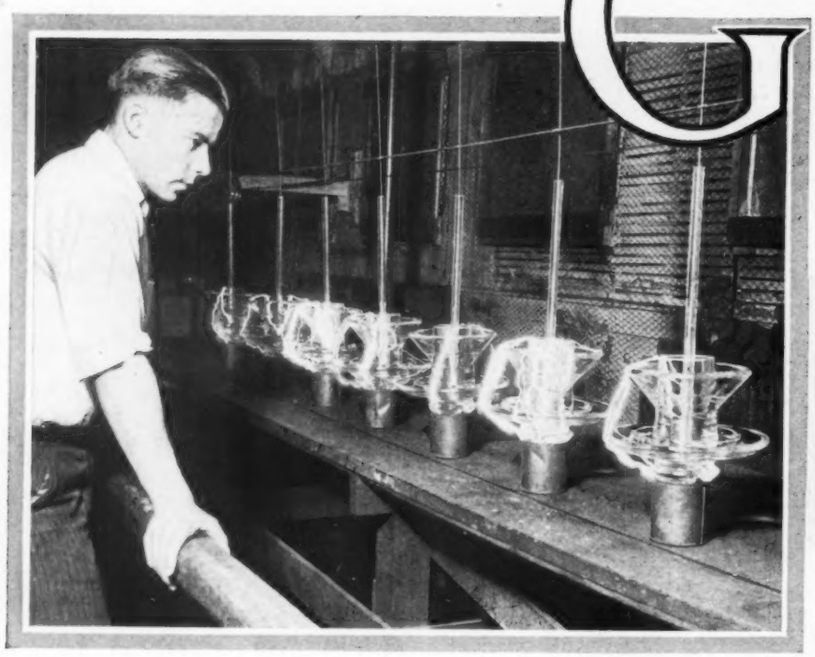
With this unusual little plow, etherized flies are separated into groups of males and females, of white eyes or red eyes

In Berlin, Germany, scientists in a unique ray laboratory have been employing fourteen kinds of X-ray machines, as well as other curious apparatus, to study the relation of rays and plant life. Besides the X-ray aids, they have installed apparatus for producing heat rays, ultra-violet rays, light rays, as well as the super-penetrating emanations of radium. Seaweed and other forms of marine plants as well as the more familiar plants of the fields have been subjected to exhaustive tests. On the roof of the building which houses the laboratory, automatic apparatus keeps tab on the exact amount of ultra-violet reaching the earth. These researches, it is expected, will prove beneficial by giving a clearer insight into the relation of growth and rays.

Far more mysterious than man-made rays are those of nature. The light of the sun seems to engender in certain plants the power to kill the Japanese beetle. Plants are known to give off potent radiations. Prof. Lieske of Mulheim, Germany, found that certain deposits of peatlike brown coal had the power to speed growth of flowers and to bring rats and mice to swift maturity. Mysterious mitogenetic rays given off by certain growing plants seem necessary for cell division and growth.

Fantastic though such experiments may seem, they open up marvelous opportunities. X-rays are harnessed to halt the ravages of cancer. Radio waves generate artificial fevers which break the grip of malaria. Electrical currents stimulate cell activity and speed circulation to ward off pneumonia. Will other unknown rays, in combination with a life-chart like Morgan's, enable man to analyze and rearrange the genes of mankind and build a new race of supermen?

Amazing New Uses FOUND FOR Glass



These glass insulators for high tension lines are tested in the factory laboratory before being sent out. In this test 130,000 volts jump the gap around without piercing them

Below, section of shatter-proof glass that has been smashed into fragments. Note there are no sharp, cutting edges as in ordinary broken glass

WINDOWS that practically eliminate heat rays from the sun; glass nuts and bolts that resist the action of acid; windshields that change into small dice-like fragments instead of splintering when shattered; transparent sheets that are half as strong as steel. Such are the recent advances in the world of glass.

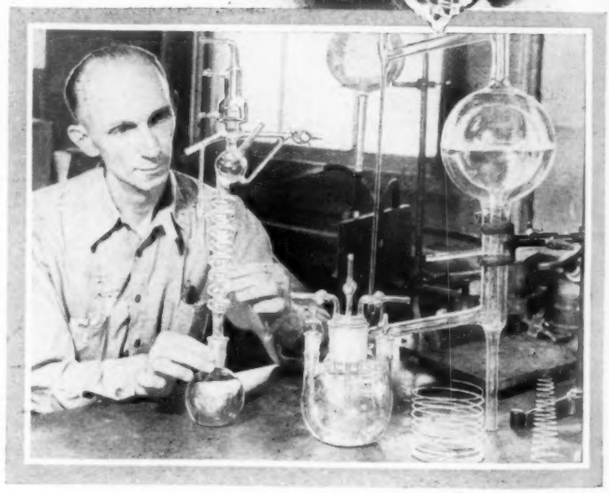
A few weeks ago, I watched a dramatic demonstration at the laboratory of the Libbey-Owens-Ford plant in Toledo, O. A steel ball, weighing more than a pound, fell from a height of eight feet, struck a pane of glass, and rebounded without leaving the slightest mark. It was dropped again from twelve feet. This time the glass shattered, but not as ordinary glass breaks. In a flash, it dissolved into granular fragments, the lines of breakage crisscrossing like the threads of an elaborate lace.

Produced by blasting cold air over the surface of glass that is almost molten, the new material is said to be half as strong as steel and three times as elastic. Two men can stand on a windshield without breaking it. The glass will bend under the weight and then return to its normal position afterwards. Used as a safety glass in Europe, it has just been introduced into this country. In a demonstration in England, not long ago, a huge pane of one-inch glass supported a three-ton truck.

The new safety material is the first commercial application of the well-known laboratory phenomenon called Prince Rupert's Drops. When molten glass is spilled into cold water, it solidifies into streamlined droplets that look like tiny glass tadpoles. The large end, almost solid, dissolves instantly into dust when the tadpole tail is snapped off. Similarly, the case-hardened safety glass disintegrates when any part of its surface is punctured.

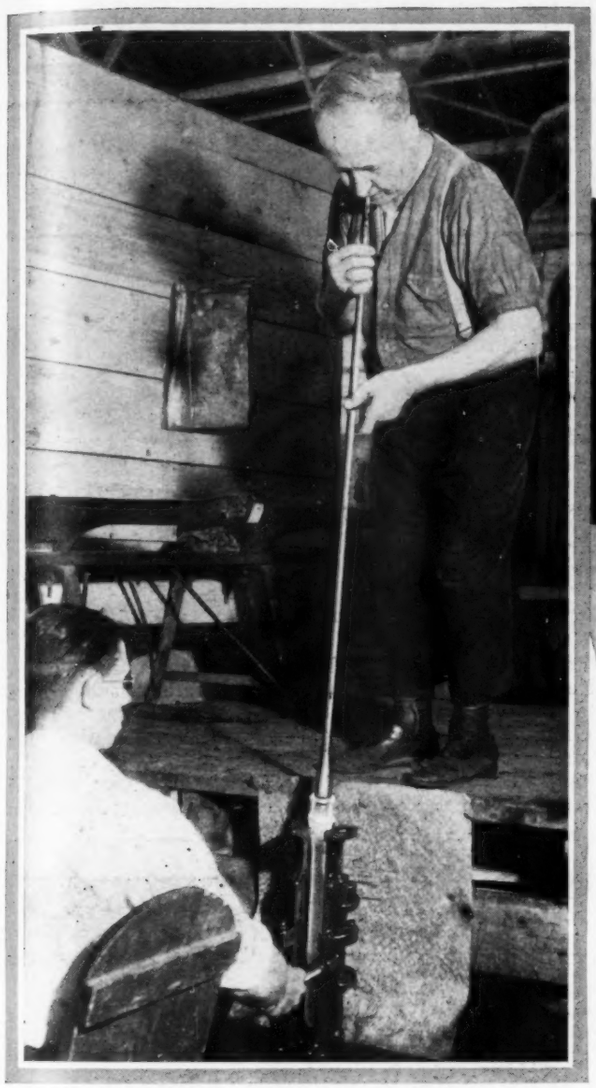
Another innovation with fascinating possibilities is a heat-absorbing window pane that cuts out seventy percent of the heat rays from the sun. Its chemical composition is such that it filters out the infra-red rays passed by ordinary panes. In Pullman cars, refrigerating plants, store windows, and homes, it may have wide application. During summer months, more than fifty percent of the sun's rays are infra-red. Consequently, the new glass is expected to clip air-conditioning bills by a large amount.

When I examined it recently at the famous Corning Glass Works, at Corning, N. Y., the only difference from ordinary panes that I could detect was a slight greenish tinge.



Here are a few of the unusual pieces of chemical apparatus for use in the laboratory that are now being made of heat-proof glass

At the opposite extreme, is another product of the same plant. It is a glass that transmits heat rays but cuts off light rays. An eighth of an inch thick, it is designed for therapeutic work in hospitals. So effective is it that heat, coming through the glass, will light a bit of tissue paper held in space without the holder being able to see the source of the rays.



Modern glass blower shaping an odd-sized bulb. In this operation, the form is closed, lubricated with graphite, and the glass whirled as the air is blown into it. In this way any desired shape is formed

Above, tin can with glass in top so the contents can be inspected by the purchaser. At left, glass bolt and nut for use in acid tanks

By Edwin Teale

•

Almost every week of the year, at the Corning plant, new glasses for special purposes are created by a laboratory and development staff that numbers almost 100. Nearly 300 kinds are standard compositions for which regular orders are taken. To the visitor, such a plant is a vast stage filled with life, with color, with infinitely varied activity.

Men, wearing masks and hiding behind steel shields, feed the raw materials into furnaces that turn the charge into molten lavalike glass. Sprayed by high-pressure flames, this lava reaches a temperature well above 1,500 degrees Centigrade. Nothing but noble metal pyrometers will record such heat. Men, peering through these pyrometers that translate the color or intensity of light from the molten mass into temperature readings, determine the heat of the melted glass. From small gas-fired "glory holes" used to reheat solid cane glass, the furnaces range through gigantic beehives of fire brick containing from one to sixteen pots to enormous "tank-furnaces" holding thousands of tons of molten glass.

Glass blowers, cheeks puffing out like twin balloons, work on wooden platforms half circling the furnaces. Men with tailor's shears clip gobs of molten glass that flows like red taffy from the ends of rods, to fill the molds of a moving machine. In another room, the boremakers, ace men of the glass works, manipulate bubbles of air within masses of molten glass. Working in darkened booths, they determine the bore of thermometer tubing which is pulled straight up 175 feet into the air within a tower rising through the roof of the building. In the case of clinical thermometers, the bore is often finer than a human hair. Yet, by getting the right proportion of bubble to glass, these experts exactly determine it beforehand. Only a handful of men ever attain the skill and judgment necessary for the work.

On an upper floor, a whole end of the building is given over to the making of chemical apparatus. A thousand and one strange, twisted forms of glass, many looking like the creations of a Hollywood director, come from the room. Most are made to special order, the requests coming from all parts of the world. Along one wall hang hundreds of curious wooden-handled holders known as snaps. They are employed in holding the pieces of glass that are heated and fused together. The chemical apparatus room is a "lamp shop," all the work being done by heating tubing and bulbs in blast lamps instead of through the use of furnaces.

Special orders and small-volume work is all hand made. When production demands rise, special machines are designed to speed up the output. I watched one amazing mechanism of the kind at the Wellsboro, Pa., plant of the Corning Company. Hour after hour, endless belts of molds pour out electric light and radio bulbs, as many as 442 a minute. The product of two Corning engineers, this robot glass blower turns out better and more uniform bulbs than the most skilful of workers.

In another plant, automatic machines feed the furnaces, pull the glass, cut and sort tubing at the rate of 150 miles a day. One recent innovation in the tubing line is a multibore product for use in Neon signs. As many as three or four channels run side by side in the tube to permit different-colored gases to glow in close proximity for novel display effects.

A crack staff of chemists, physicists, and optical experts keep busy developing new glasses, testing standard articles, and finding new uses for glassware. Polarized light is shot through glass to seek out strains that may develop into flaws. Elaborate optical instruments study the properties of new creations. Crackling blue flames cascade over high-tension glass insulators, subjecting them to as much as 130,000 volts of electricity in a hunt for hidden defects.

IN THE long, romantic history of glass, which stretches back to Venice of the Middle Ages and far beyond, this universal material has never had as many uses as it has today. On the market you find glass wool, glass bricks, glass blackboards, and even glass sparkplugs for motor cars.

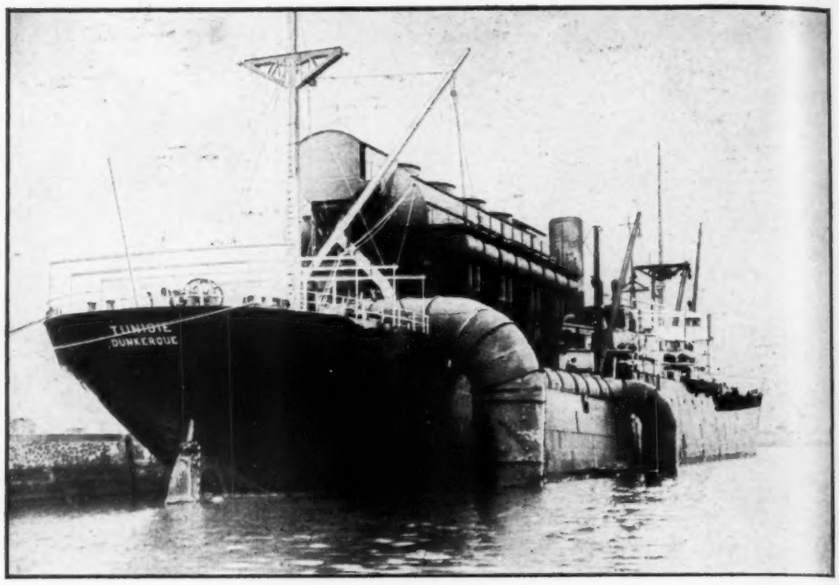
Within recent months, a tin can with a glass window that permits shoppers to inspect the contents before buying, has appeared on the market. It is the product of Corning research men in collaboration with Continental Can Company, the disk of glass being soldered directly to the metal by a secret process. The same brand of glass that is used in the 200-inch telescope mirror is used in the windows of the cans. Americans buy 12,000,000,000 tin cans a year and the new container is expected to prove a potent selling aid. Recently, tests conducted in the middle west showed a 340 percent increase in the sale of vegetables and fruits packed in such containers.

Another unique product of the glass industry is a milk *(Continued on page 118)*

NEW COMB COMES APART FOR EASY WASHING

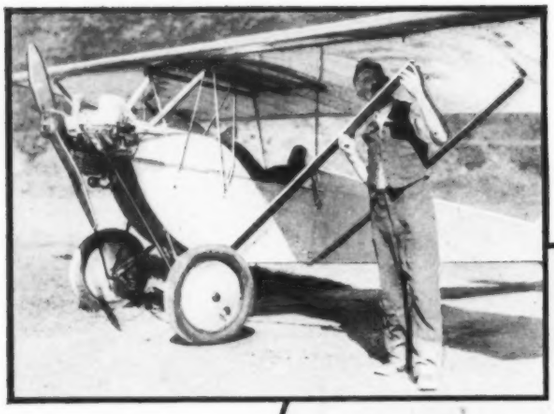
A HAIR comb that comes apart for cleaning has been devised by a Nevada inventor. When a knurled nut at one end is unscrewed, the prongs of the comb are released as shown in the photograph above, and may then be washed conveniently with soap and water. The prongs are assembled in a jiffy by lining them up in their proper position for use and then securely tightening the nut.

SHIP TO MAKE ICE FROM OCEAN'S HEAT



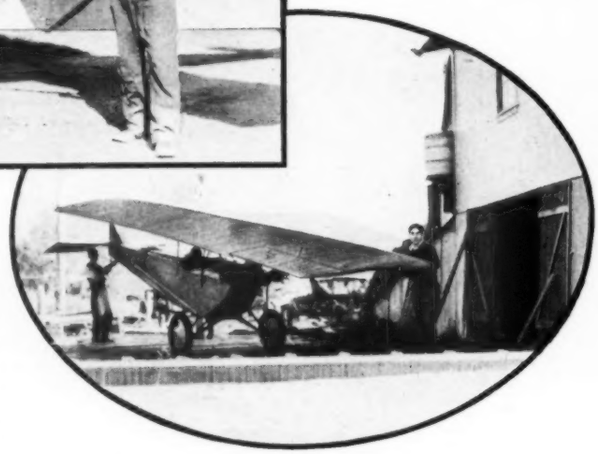
HARNESSING the warmth of tropical sea water to run a floating ice plant is the strange experiment soon to be attempted off the Brazilian coast by Georges Claude, noted French inventor. Warm water from the sea's surface will be pumped aboard the converted freighter *Tunisie,* where it will turn to vapor of its own accord in boilers kept under a partial vacuum. Steam so produced will run turbines and generate electricity to operate an ammonia ice-making plant of standard design. The steam will then be condensed by cold water drawn through a 2,200-foot pipe from the ocean depths, thus maintaining the vacuum through the system.

PLANE'S WING FOLDS TO FIT GARAGE



Left, Jacob Sellmer, inventor of folding wing plane, adjusts the machine's wing, thus making it ready for a trip in the air

Below, photo shows the plane with wing folded lengthwise of the machine so it fits garage



AN AIRPLANE that folds up helps Capt. Walter B. Sellmer, Marin County, Calif., fish and game warden, patrol his vast territory. When he returns from an inspection trip, a few adjustments permit the single wing of the machine to be rotated lengthwise of the plane, which is then trundled into the garage of his home. Straightening and locking the wing for another flight is only a matter of moments. Jacob P. Sellmer, veteran sheriff of Marin County and father of the game warden, turned inventor to design and perfect the unusual craft for his son. Sellmer, senior, spent a year working on the plane before he was able to make it meet his requirements. With the exception of the folding wing, the machine differs only slightly from the small planes that are now used for private purposes. He is continuing his work in a effort to produce a plane that will rise and land vertically since this type of plane would be of great assistance to his warden son in the discharge of his regular duties.

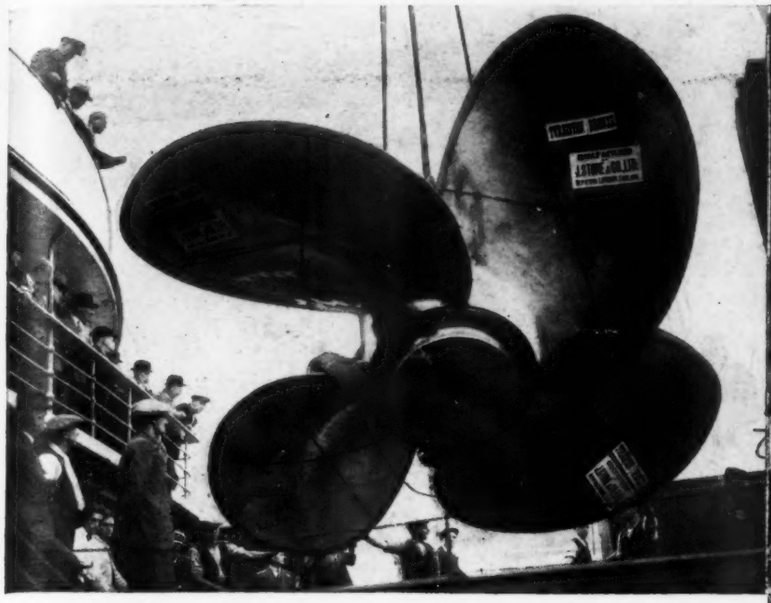
SHATTERPROOF GLASS USED IN SPECTACLES

HAMMER blows cannot shatter the glass in safety spectacles recently developed in England. Under the impact of the metal, the lenses crack as does the safety glass used in automobiles, but the broken fragments will not scatter. The glasses are designed for athletes, workers, and others who run the risk of having their spectacles struck by flying objects.

REPEATING SLINGSHOT

A REPEATING slingshot, recently placed on the market, makes it possible to shoot 200 BB shot without fumbling about for ammunition and without reloading. The magazine is a metal cone that fits into the wire frame of the slingshot, forming a grip. The tip of the cone, slotted to form a prong, admits a single shot from inside the magazine.

Propellers Cast for Super-Liner



One of the thirty-five-ton screws just before its installation on the new British liner

Top, reshaping the blades of the casting with pneumatic chisels. Above, preparing the sand mold for the casting

FOUR huge propellers, installed on Britain's super-liner "534" shortly before its scheduled launching on the River Clyde in Scotland, represent the biggest and most exacting casting job of its kind ever attempted. Weighing thirty-five tons apiece, they were made of manganese bronze—an alloy of copper, zinc, and manganese favored for ships' screws because it will bend but not break on colliding with objects. For each propeller, forty-five tons of the molten metal were poured into a brick-walled mold. An opening or gate in the mold's top held the ten tons of excess metal, whose added weight forced out air bubbles and insured a perfect casting. After two weeks' cooling the casting was removed and measured for pitch. Shrinkage made a little re-shaping necessary, and a "chipper" cut grooves in the blades to a depth indicated by chalked figures, using a pneumatic tool known as a cape chisel. A second chipper with a flat chisel then removed the ridges. After checking the propeller for balance, and polishing it with a power buffer, it was ready for installation in the mammoth ship which is nearing completion.

NOVEL SPRINKLER FOR WINDOW BOXES

TO WATER second-floor flower boxes for a neighbor who had gone away for a vacation, a New Yorker devised an unusual sprinkler. With a twelve-foot pipe extension for a garden hose, and a T-shaped sprinkler, he was able to water the aerial garden from the sidewalk.

PUSH-BUTTON PLANE MAKES FLYING EASY

PILOTING an airplane is made even easier than driving an automobile by a new control system tested recently in France. The machine is equipped with five control buttons mounted on a panel in the cowl and labeled, "Ascent," "Horizontal Flight," "Turn to Right," "Turn to Left," and "Descent." When the pilot touches any one of these buttons with his finger, the airplane performs the corresponding evolution. The buttons may be pressed in various combinations to perform more complicated maneuvers, such as spirals. Additional controls, operated as simply, make taking off and landing completely automatic operations which require no judgment on the part of the pilot. A wind-speed gage in the take-off mechanism adjusts the control surfaces so that the plane rises of its own accord when it has attained the necessary velocity, and the landing mechanism brings the machine down by the use of the same principle. When the plane is in flight, it is kept on its course and prevented from rolling or yawing in occasional air currents by three sets of automatic stabilizers. By pulling out three levers, the pilot may disengage these stabilizers and fly the airplane with a control stick in the conventional way. According to the inventors, the push-button control system can be installed in airplanes of all types and will enable a novice to fly them as safely as a professional pilot. The simplicity of the control system is also said to be well adapted to operation by radio from the ground if remote control is desired.

Control buttons put the plane through its various maneuvers, enabling a novice to pilot it

CAST-IRON PAVEMENT FOR CITY STREET

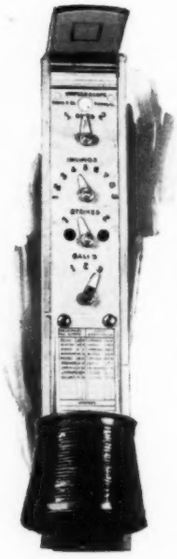
SEEKING a paving material that will stand up under heavy traffic, University of Minnesota experimenters will soon supervise the laying of what is believed to be the country's first cast-iron street. Permission to use one of the most heavily traveled streets in Minneapolis for the experiment has just been granted. The iron will be cast in triangular slabs.

TEST TAILLESS PLANE FOR WAR USE

BELIEVING that the stumpy type of airplane known as the "pterodactyl" has superior qualities as fighting craft, an English engineer is now testing for war use one of several of these experimental ships he has built. The fighting pterodactyl is a two-place biplane and, like other planes of the type, has no tail, the rudders and elevators being carried at the tips of the swept-back upper wings. The lower wings are mere stubs. The lack of a tail and the curious wing structure is said greatly to increase the gunner's field of view and to widen the range of fire of the plane's machine guns. These two advantages, it is claimed, will be of vital importance in an actual combat, and it is for that reason that the plan is being developed.

NUMBERS ON FLOOR AID BROADCASTERS

TO INSURE proper position on the part of performers while they are broadcasting musical programs, a radio studio in London has adopted carpets and rugs that bear conspicuous letters and numbers. In rehearsals, the performers are assigned places from which their voices or the sounds of their instruments are picked up best by the microphones. Then it is easy for them to assume identical positions during the broadcast.



NEW AID FOR BASEBALL UMPIRE

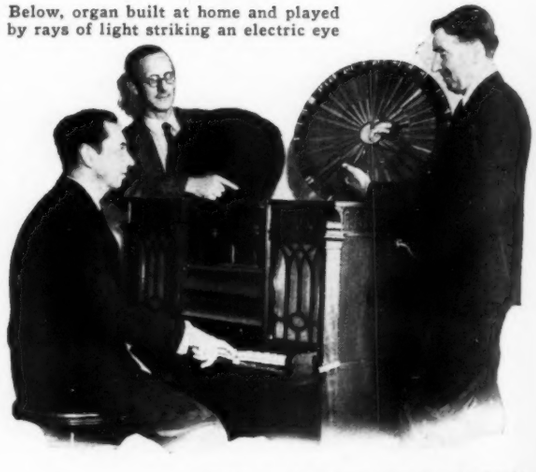
BY ENABLING a baseball umpire to observe the flight of a pitched ball with accuracy, a new sighting instrument is intended to lessen the chance of squabbles over decisions. The device has a small sight mounted at each end of a narrow panel. When the umpire behind the batter looks through these sights, his view is confined to the space above the plate between the batter's knee and shoulder.

ELECTRIC EYE PLAYS HOMEMADE ORGAN

PIPE-ORGAN music without pipes is produced on a homemade instrument built by two ingenious Los Angeles, Calif., men. The sound is created by the play of a flickering beam of light upon an electric eye, which converts the beams into audible tones corresponding to the scale of the usual organ. In playing the pipeless organ, a musician touches the keys of what appears to be an ordinary keyboard. These keys, in reality, are electrical contacts which cause two disks within the organ to revolve. One of the disks has strips radiating from its center that resemble sound-movie tracks. The other is perforated with tiny holes somewhat on the order of a television scanning disk. Together, these disks regulate the intensity and pattern of light that falls upon the electric cell, causing it to transmit impulses to the sound mechanism.

Sound track used in homemade pipeless pipe organ

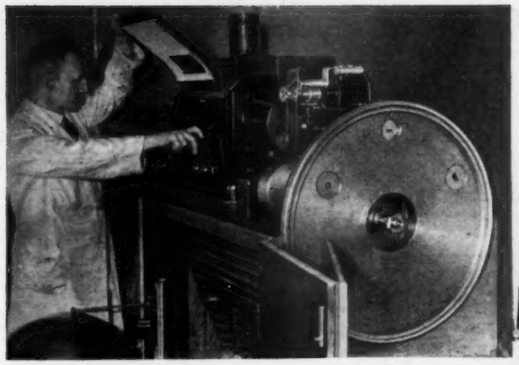
Below, organ built at home and played by rays of light striking an electric eye



NEW METER REGISTERS ANY CURRENT VOLTAGE

SOCKET voltages on either alternating or direct current can be measured by a newly developed meter that turns the current into light and then measures the quantity of light. A conversion table attached to the instrument makes it possible to translate the light readings into volts. The meter employs a carbon filament lamp, a type that is more sensitive than a tungsten lamp to minor voltage fluctuations. The light given off by the lamp falls upon a photronic cell, or electric eye, and is indicated by a needle on a dial. By checking the dial reading against the conversion table, the voltage is determined instantly. Ordinarily, separate voltmeters are necessary in measuring direct and alternating current. The table which converts the candlepower into volts encircles the cylinder on the top of the device, as shown above.

The table on this meter converts candlepower into volts and so measures current

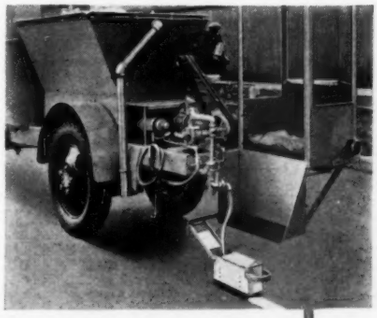


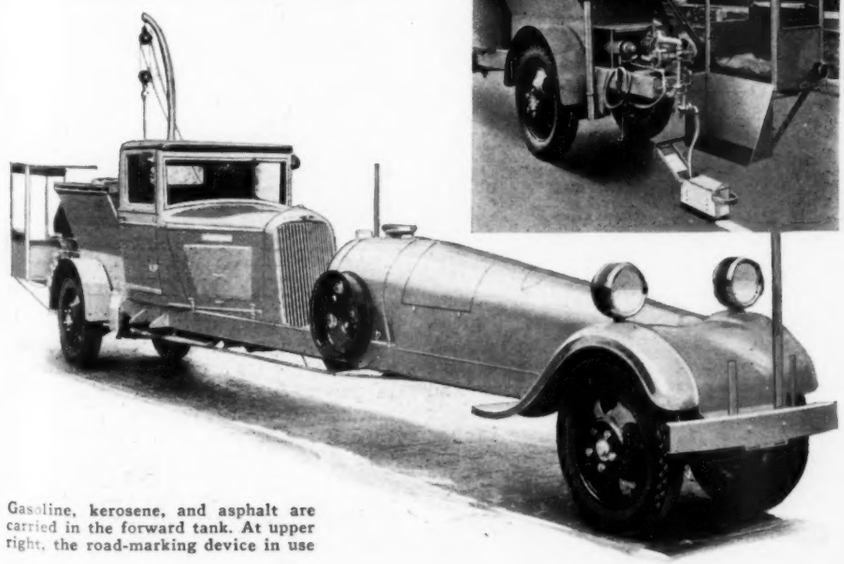
NEWS BROADCAST TRUCK HAS TELEVISION SYSTEM

TO BRING to the eyes of radio listeners, new events from the places at which they occur, a new type of television truck has just been placed in service by German broadcasters. It employs a delayed transmission system of recent invention (P. S. M., Dec., '33, p. 51), in which a scene is in rapid succession, first photographed, and then televised. A motion-picture camera on the roof of the truck is trained upon the principal point of interest. While it is in action, its exposed film passes continuously through an aperture in the roof and then races through a developing tank, a fixing tank, and a television transmitter in the truck. The special developing process works at such high speed that only a minute and a quarter elapses before the original scene is on the air. Through this indirect transmission system, radio pictures of unusually good quality are said to be obtained, since the developed film is better suited to television transmission than the scene itself. The film can be dried and projected in a theater, as well as broadcast for television reception.

AUTOMATIC ROAD MARKER ON TRUCK

A CURIOUS new automobile truck, resembling a lean, white dachshund, is now in use on Indiana highways. It contains not only an automatic road-marking device but also machinery necessary for making minor road repairs. A bullet-nosed structure in front of the engine and cab of the long, narrow truck contains tanks for kerosene, gasoline, and asphalt. The asphalt is heated in another tank behind the cab over a flame fed by kerosene. Also behind the cab are located an air compressor, driven by a small gasoline engine, the road-painting equipment and a supply of sand. The heated asphalt is used to repair shoulders of concrete roads and the sand is spread over the newly laid surface. The compressor supplies air for both the kerosene burner and for the road-marking device. Entering the paint reservoir, the air forces the paint through a spray box that trails the truck and leaves a straight, even line on the road. Two masts, mounted fore and aft of the forward tank, are used by the driver as sights in maintaining a straight course along the highway. By this means, lines can be laid for long distances in little time.





Gasoline, kerosene, and asphalt are carried in the forward tank. At upper right, the road-marking device in use

FAN FOR AUTO WHEELS KEEPS THE TIRES COOL

THE TEMPERATURES of tires used on the big wheels of trucks and buses can be greatly reduced, it is said, by a new fan-like ventilating device built into the outer of the pair of wheels. The high temperature induced in such tires hastens the deterioration of the rubber. Heat is reduced with the new attachment which blows a stream of air through the spokes of the outer wheel. Striking the rims of both tires and the brake drum, the air carries off much of the heat that would otherwise be absorbed by the tires.

RADIO SAVES BAD TEETH

KILLING germs that cause decay in teeth by means of high-frequency radio waves is the treatment proposed by Dr. J. S. Oartel and E. Alfred Wolf, of the University of Pittsburgh, Pa. In tests they found the waves more than twenty-five percent effective.

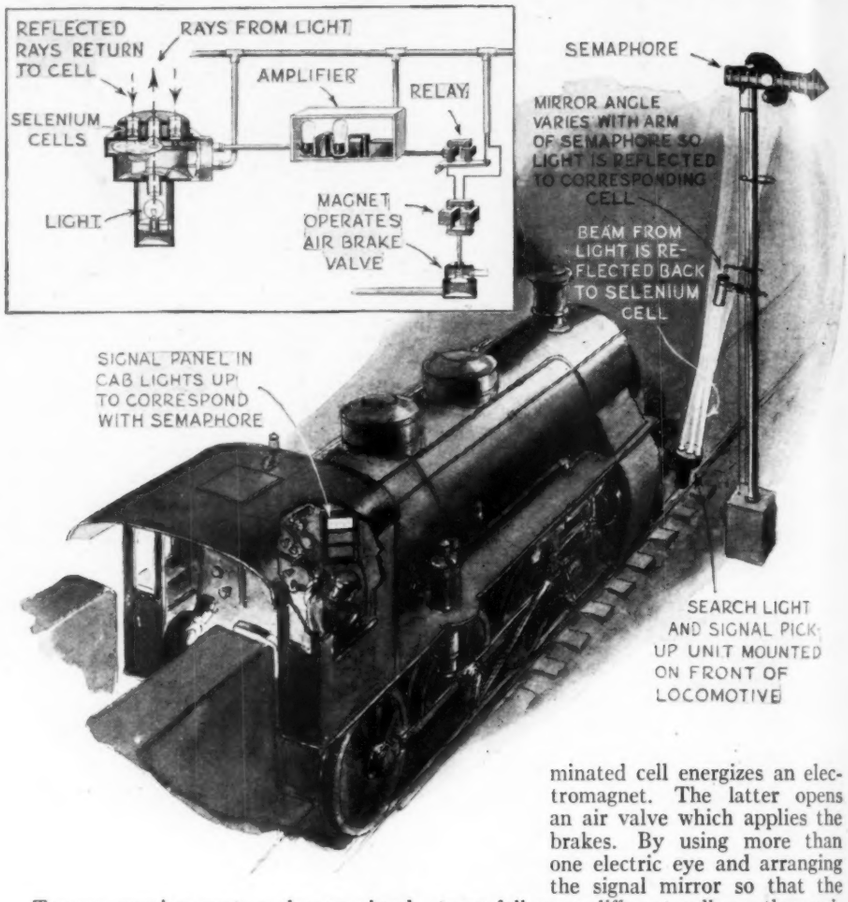
Electric Eye Prevents Train Crash

RADIO SETS FOR HIKERS

ALTHOUGH his wanderings may take him along trails remote from other means of entertainment, a hiker may still enjoy his favorite radio program with a recently developed midget set. The set, now in use in England, is slung over the shoulder. Its two tubes are said to pick up broadcasts over a range of 100 miles. The wires connecting the earphones are long and flexible. The battery of the set will give good service for a year.

SMALLEST ELECTRIC FURNACE

SCARCELY larger than a spool of thread, an electric induction furnace, used by a manufacturer for demonstration purposes, is capable of melting metals with the speed of lightning. A small piece of molybdenum, a metal having a melting point of 4,757 degrees Fahrenheit, can be melted in five to six seconds. Heat is set up within the metal by high-frequency electricity.

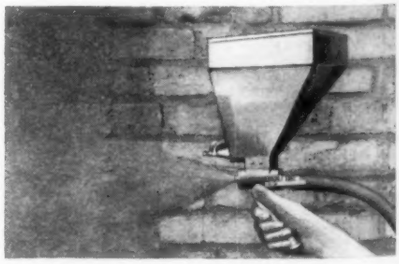

REFLECTED RAYS RETURN TO CELL
RAYS FROM LIGHT
AMPLIFIER
RELAY
SELENIUM CELLS
LIGHT
MAGNET OPERATES AIR BRAKE VALVE
SEMAPHORE
MIRROR ANGLE VARIES WITH ARM OF SEMAPHORE SO LIGHT IS REFLECTED TO CORRESPONDING CELL
BEAM FROM LIGHT IS REFLECTED BACK TO SELENIUM CELL
SIGNAL PANEL IN CAB LIGHTS UP TO CORRESPOND WITH SEMAPHORE
SEARCH LIGHT AND SIGNAL PICK-UP UNIT MOUNTED ON FRONT OF LOCOMOTIVE

TRAINS running past a danger signal are halted automatically by a safety device tested on a Bavarian railroad. The outfit consists of a light and a photo-electric cell carried behind the buffer of the locomotive, and a mirror that is attached to a semaphore standard. The mirror is so arranged that when the semaphore is in the danger position, it reflects the beam of light from the locomotive. The reflected rays strike the electric eye and the current transmitted by the illuminated cell energizes an electromagnet. The latter opens an air valve which applies the brakes. By using more than one electric eye and arranging the signal mirror so that the rays fall upon different cells as the position of the semaphore changes, starting as well as stopping can be controlled automatically. A further variation calls for a signal board in the engineman's cab. This would contain signs which would light up in agreement with the position of the semaphone as observed by the electric eye, thus bringing the distant signal immediately before the eye of the engineer and so greatly reducing the chance of an accident.

Lightning painted this picture of its movements in lines of burned grass on the heavy grassy surface of a Washington, D. C., golf green

LIGHTNING'S PICTURE ON GOLF GREEN

DURING a recent electrical storm near Washington, D. C., one lightning bolt left its "portrait" upon a golf green. Golfers who arrived at the green after the storm found the picture outlined in branching lines of seared grass. The bolt struck the down slope of the banked green and bored a vertical hole forty-three inches deep. Two streaks from the bolt plowed furrows down the slope and another raced up to the green.



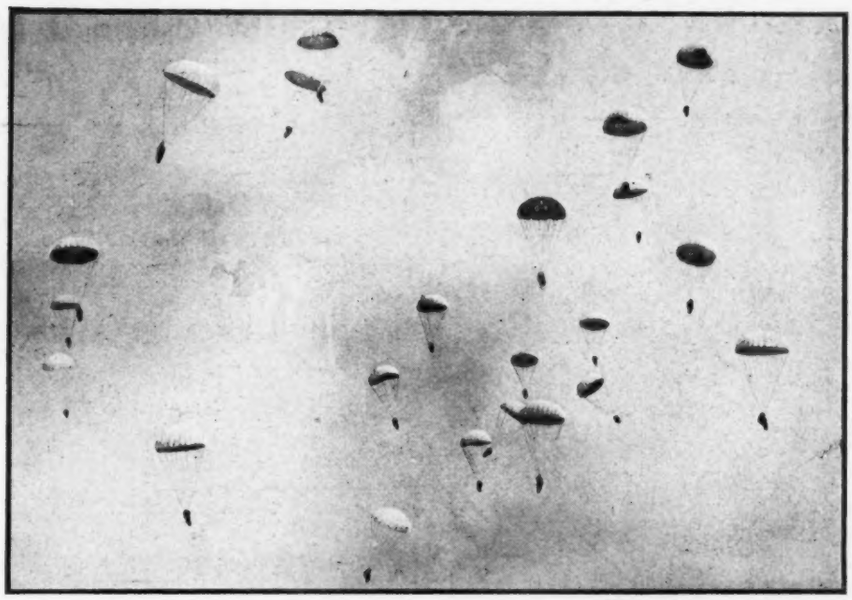
NEW SPRAY GUN PUTS STUCCO ON BUILDING

OUTSIDE walls may be brightened up by a new type of compressed-air spray gun that applies a coat of stucco instead of paint. A small hopper fitted to the gun holds enough of the semi-liquid stucco to cover a considerable surface of the wall at one filling. A trigger controls the flow of compressed air and a pistol grip permits the device to be handled easily, as shown above. On frame buildings, the walls must be covered with metal lath.

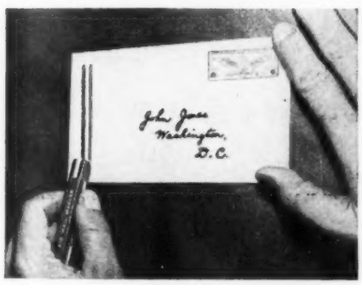
REVOLVING HAT NEW ADVERTISING STUNT

A SPINNING hat bearing advertising messages is the latest wrinkle for sandwich men in Paris, France. A concealed switch enables the wearer to start the hat revolving or stop it at will. Lest even this strange apparition fail to arrest the eyes of passers-by, the hat is also equipped with lights that flash on and off at the wearer's control by means of a concealed switch.

TWENTY-FIVE BAIL OUT OF ONE PLANE



TWENTY-FIVE parachute jumpers floated to earth recently from a single airplane, above Moscow, to set aviation history. Mass leaps had been attempted previously in other countries, but the feat of the Soviet jumpers was the first in which so many men had bailed out at one time from a single ship. As the giant plane bearing the parachutists flew over the Tushino aerodrome near Moscow, the men leaped out in rapid succession. All of them drifted to earth without mishap.



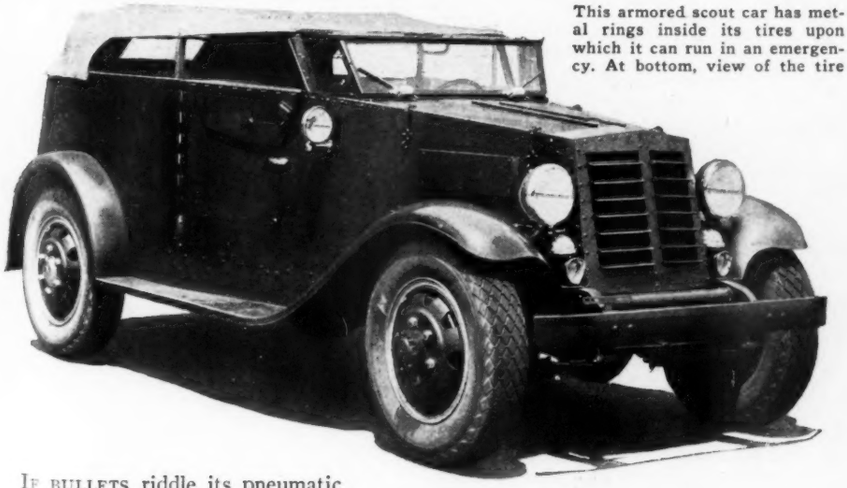
USE THREE-COLOR CRAYON TO MARK ALL AIR MAIL

LETTERS intended for the air mail are unmistakably marked by a combination red, white, and blue crayon recently placed on the market. Merely drawing the crayon once across an envelope is sufficient to have it identified with the official three-color striping. This makes certain that it will go to the airport and not be held with ordinary mail.

TWO TINY WHEELS KEEP NEW BICYCLE UPRIGHT

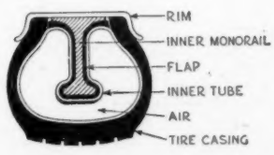
A FOUR-WHEELED bicycle which recently made its appearance in Germany may be mounted easily, even by a beginner, and may be parked anywhere. Two small auxiliary wheels are attached by movable brackets to the frame of the cycle and are raised or lowered by moving a lever on the handle bar. So long as these wheels remain lowered, the cycle stands upright as shown above. When in motion, they are raised.

ARMY SCOUT CAR HAS MONORAIL TIRES



This armored scout car has metal rings inside its tires upon which it can run in an emergency. At bottom, view of the tire

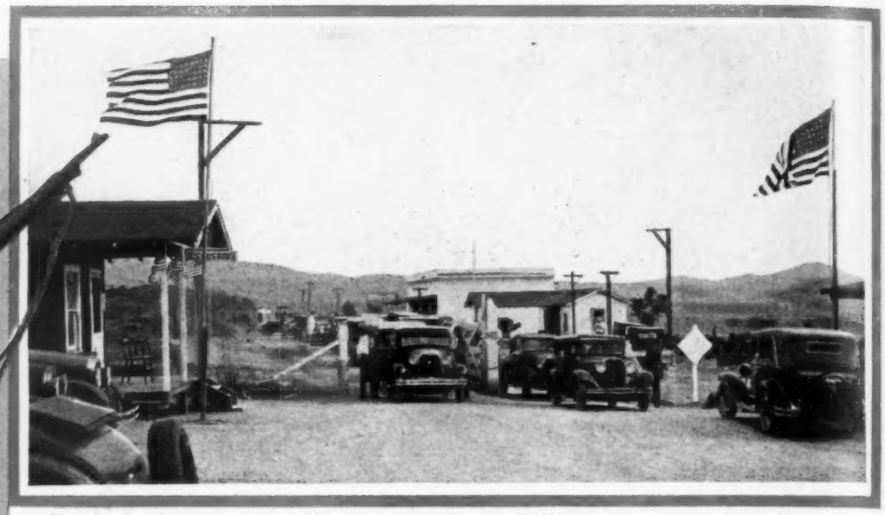
IF BULLETS riddle its pneumatic tires, a high-speed armored scout car of new design, intended for military use, can travel as far as twenty miles to safety on monorails or safety rings of duralumin within the tire casings. The car seats a driver and three machine gunners, and can travel at speeds up to seventy miles an hour. All four of its wheels are driving wheels.



PLAN FOUNTAIN PENS OF CHICKEN FEATHERS

FOUNTAIN pens, combs, buttons, and novelties from chicken feathers are forecast by recent researches made at Iowa State College. The Iowa experimenters have shown that feathers, dissolved in caustic soda, can be converted into a new material that may have many uses.

Border Guard Wages



Even at lonely ports of entry like the one at Tecate, Calif., shown in this photograph, the customs and immigration patrolmen are occasionally swamped with traffic. Every car must be searched and every person entering the United States must be investigated before proceeding

CROUCHED beside a squat tumbleweed not fifty feet from the rusting monument that marks the boundary between California and Baja California hard by the sea, the border patrolman scanned near-by hills with his powerful glasses. He was V. E. Williams, one of Uncle Sam's mounted border officers, and he was keeping vigil on a lonely section of the border awaiting the coming of a smuggler whose habits he had been observing for several days and nights.

From his position he could see the crown of the hill in a broad semicircle to the south. Not a creature could come over and remain hidden. For two hours he watched and waited while not a sound disturbed the silent night. Then he heard a faint purring. Cautiously he arose on one knee. The purring became louder. Through the haze he could see the dim outline of a small boat approaching the border.

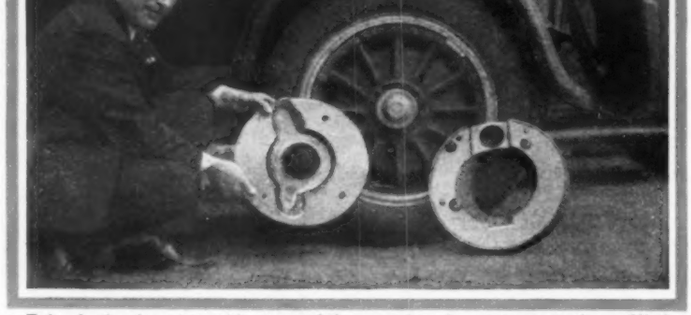
Five minutes later the patrolman pointed his Very pistol toward the sea. Plop! A ball of white fire rose in a graceful arc. He fired a second signal, and before its light died away he was racing through cactus and small bushes toward the sea. A half mile further north other officers joined the chase. Out to sea a fast motor boat bounded across the waves. Quickly the officers closed in, the inbound boat driving the smuggler ashore.

Every night, somewhere along the far-flung borders of the United States, border patrolmen halt new invasions of smugglers. Despite repeal, alcohol in various forms continues to prove a profitable contraband. Aliens pay substantial prices for delivery to inland cities. Smugglers of narcotics receive high fees for transporting small boxes of dope to dark clearings serving for a moment as landing fields. Beautiful Mexican mantillas, cheap foreign cigarettes, shoes made abroad, even American-made goods exported duty-free find their way across the borders into eager hands.

Hundreds of thousands of foreign visitors enter the country legally every year. At each port of entry, alert patrolmen question every traveler, examine each car. Through mirrors set at an angle in the edges of concrete platforms they view the bottom of every vehicle. Lights set in the pavement supply illumination at night.

Both people and goods are caught in many hidden recesses. One large sedan joined the fleet of captured rum runners when inspection revealed the brake drums were copper containers filled with alcohol. In another, two aliens were found back of the rear seat. A coupé yielded two from a compartment behind the seat.

But the drama of the borders is being written in lonely, out-of-the-way stretches of desert, sea, and mountains where keen-eyed patrolmen wage eternal war to beat back smugglers and stop the illegal flow of goods and persons into the United States.



False brake drums on this automobile proved to be copper containers filled with alcohol. Clever ruses employed by smugglers call for eternal vigilance

Though the immigration service is interested primarily in persons, customs in things, and the coast guard in both, officers are seldom sure of what they will catch until the arrest actually is made. They go about their plans with military precision, covering a sector much as an army division guards all points on a front, though with infinitely fewer numbers.

The entire immigration watch from Chula Vista was assigned recently to the western sector near Nestor, Calif., covering the Pee Vee road. Somewhere around Nestor or Imperial Beach, they suspected, smugglers would

War on Smugglers

Daring Patrolmen in an Endless Fight To Halt the Traffic in Aliens and Contraband

Where the border meets the sea, fast motor boats aid the guards in capturing contraband cargoes. Lonely coasts offer refuge to smugglers

By

ANDREW R. BOONE

Two members of the border patrol on duty. One scans the brush and the other is ready with a riot gun

come across the line during the night and make for points north. Two inspectors were stationed in the Emery schoolhouse, which commands a view of three roads and the fields between them.

Meanwhile Roy B. Newport, in charge of the watch, was returning to Nestor to take up a hidden position. While gliding down a hill with his lights out he saw a figure cross the highway.

"Where are you bound, stranger?" Newport asked, as his car rolled to a stop.

"I'm in a hurry," came the whispered reply. "I've just come over the line through the river bottom."

"That's good news," responded Newport. "Stick up your hands and I'll conduct the tour."

He ordered the smuggler into his car, handcuffed him to the wheel and set out with drawn revolver after three Orientals he could see in the bushes. Sand from the dry river bed, found in the trouser cuffs, linked the border runner with the contraband and not only sent him to a federal prison, but brought confessions which resulted in the conviction of the "brains" of the gang, Clarence K. Aiken, former army officer, who is now serving 19½ years at McNeil's Island. This is the longest sentence ever handed a smuggler.

Aliens often are brought into ocean ports, whence they are whisked away to population centers. Dusk or dawn are the favorite times. Runners leave near-by foreign ports, sail outside the twelve-mile limit, then under cover of darkness return to land unseen. They take off in airplanes, head straight out to sea at altitudes so low they cannot be seen from shore, cutting in when safely beyond the vision of officers on the border.

All planes are numbered. If one strange to the locality appears, border patrolmen watch its movements closely. It may be spotted taking off from a Mexican or Canadian field in early morning or late at night. Who meets it? If met by a suspicious character or known smuggler, that pilot's movements are closely watched.

This copper container, shaped to fit the seat of a coupé, carried alcohol across the border until customs patrolmen arrested the driver

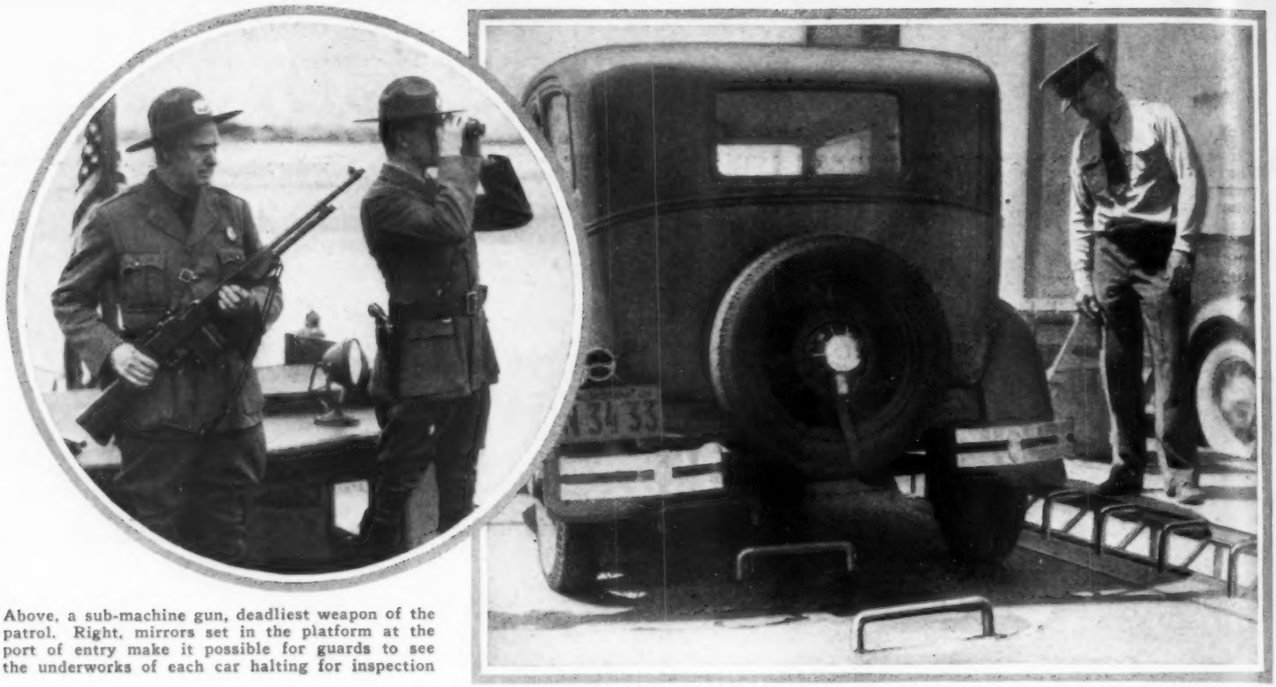
To date the patrolmen have been seriously handicapped by having to operate with automobiles only. Here's where the coast guard enters the picture. Flying in land planes and amphibians, armed with long-distance telescopes and machine guns, their pilots now not only can catch smuggling planes along the borders, but also can chase them out to sea or cut off their retreat to the border and hover over them until fuel expended, they finally are forced to land and surrender to officers.

Coast guard planes, assigned to this particular work, extend the range of vision enormously. In two or three hours an alert pilot, cruising a mile up, can locate and radio to the patrol force commander the name and location of every boat in his area within twelve miles of shore, report conditions along wild stretches of coast line and uninhabited inlets and call for patrolmen in fast motor boats to speed out from their base to turn back or capture smugglers threatening to rush the coast.

"The effect," explained one pilot, "is largely strategic. Our presence alone halts some running of the borders because smugglers know a radio message will send officers on their trail."

Airplanes and radio communications, denied the border patrolmen until the last few weeks, are expected to make possible the halting of a threatened invasion, particularly of liquor, which has been piling up in Mexico. In Ensenada, Baja California, for instance, the border patrol is informed 150,000 cases of alcoholic beverages are now stored. It was taken there because Ensenada is a free port. It must be moved in sixty days. Where? Probably to southern California on small boats and in trimotor airplanes, carrying as many as 200 cases on each run.

A similar invasion, threatened along the Texas border in an effort to escape import duties, is being met by mounted patrolmen equipped with field-radio sets. Eighteen members of the border patrol have been killed by desperate smugglers in Texas in ten years. Every month witnesses a gun fight as smugglers blast their



Above, a sub-machine gun, deadliest weapon of the patrol. Right, mirrors set in the platform at the port of entry make it possible for guards to see the underworks of each car halting for inspection

way out of federal traps with six-guns and rifles.

Recently a radio station has been installed at Marfa, Texas. Patrolmen covering the border 300 miles distant report regularly from their portable sets, giving information of suspected border runners and receiving tips which frequently lead to arrests.

All the color of the wild west may be found along the Texas border. There the organized bands are interested in things rather than persons. Only officers of long experience are permitted to risk their lives against these desperate gangs.

"Usually," I was told by a grizzled Texas patrolman, "one or two lone walkers come across the border, each carrying four 5-gallon cans of 'alky,' two slung over each shoulder in gunny sacks. Following them, spread out like a line of skirmishers, come from thirty to forty more, all armed and all carrying similar loads.

"If they get through, okay; but if the advance guard is challenged, rifle fire opens up and the gang protects their retreat."

"How often does this happen?" I asked in astonishment.

"Too frequently for comfort," he said.

In New Mexico the gangs are smaller. There they head for mountain trails in groups of six to eight. Too few in numbers to halt them at the border, the patrolmen watch the line for signs of crossing. Recently four officers found a trail near El Paso and followed the fresh tracks twenty-five miles into the mountains where they captured a burro train staggering under a heavy load of alcohol.

Occasionally a smuggling band transfers its activities from one kind of contraband to another, though seldom to a new territory. They prefer to operate in territory they know. One southern runner of alcohol recently dropped that trade, but the officers soon saw him hobnobbing with two men twice convicted of smuggling aliens.

Two days after they first spotted him with criminal companions, the officers saw the same three men talking together in a saloon on the Mexican side of the line. That night they saw the suspect leave San Diego and approach the border. An hour later four mounted patrolmen followed, going to San Ysidro where they surrounded a lonely spot they thought likely to be selected as a point of delivery.

Soon after their arrival, they saw an alien enter the smuggler's car. While three other aliens escaped they captured the smuggler and his lone customer, thus assuring the smuggler a year's stretch in the federal penitentiary at McNeil's Island.

Occasionally, though not often, alert officers capture a receiving agent, hundreds of miles from the international boundary. Not long ago a boy twenty-two years old, was arrested while bringing in aliens. While out on bond awaiting trial, he made several more trips. Finally, having learned where he was delivering them, officers hid one dark night in Spofford alley, San Francisco. As the sun was breaking over the eastern mountains, four patrolmen captured him at the moment he was handing over to an agent six aliens. He was the first receiver to be caught in the act, and convicted, in California during a nine-year period. The young smuggler is credited with having delivered 105 aliens to Spofford alley before he reached prison.

Officers with smuggled goods found on one border runner. The loot includes shoes, a Mexican serape, and several cartons of cigarettes. Many kinds of goods are smuggled

Sometimes the border patrolmen find the key to smuggling closer at home. An Oriental interpreter, who long had been respected by federal agents, at last came under suspicion because of company he kept. Agents watched him leave San Diego in a boat in company with two known smugglers and early in the morning captured all three off Point Loma with nine luckless aliens cramped in the hold of the boat.

From eastern Canada, aliens seek to enter large eastern cities, particularly New York. From western Canada, they hope to gain Seattle. Those entering along the southeastern coast hope to reach inland cities, particularly Chicago. From west Mexico they filter through and dash for Los Angeles and San Francisco.

(Continued on page 122)

Phonograph Disks Run Crewless War Tank

Machines can execute complicated maneuvers and return after their mission has been performed

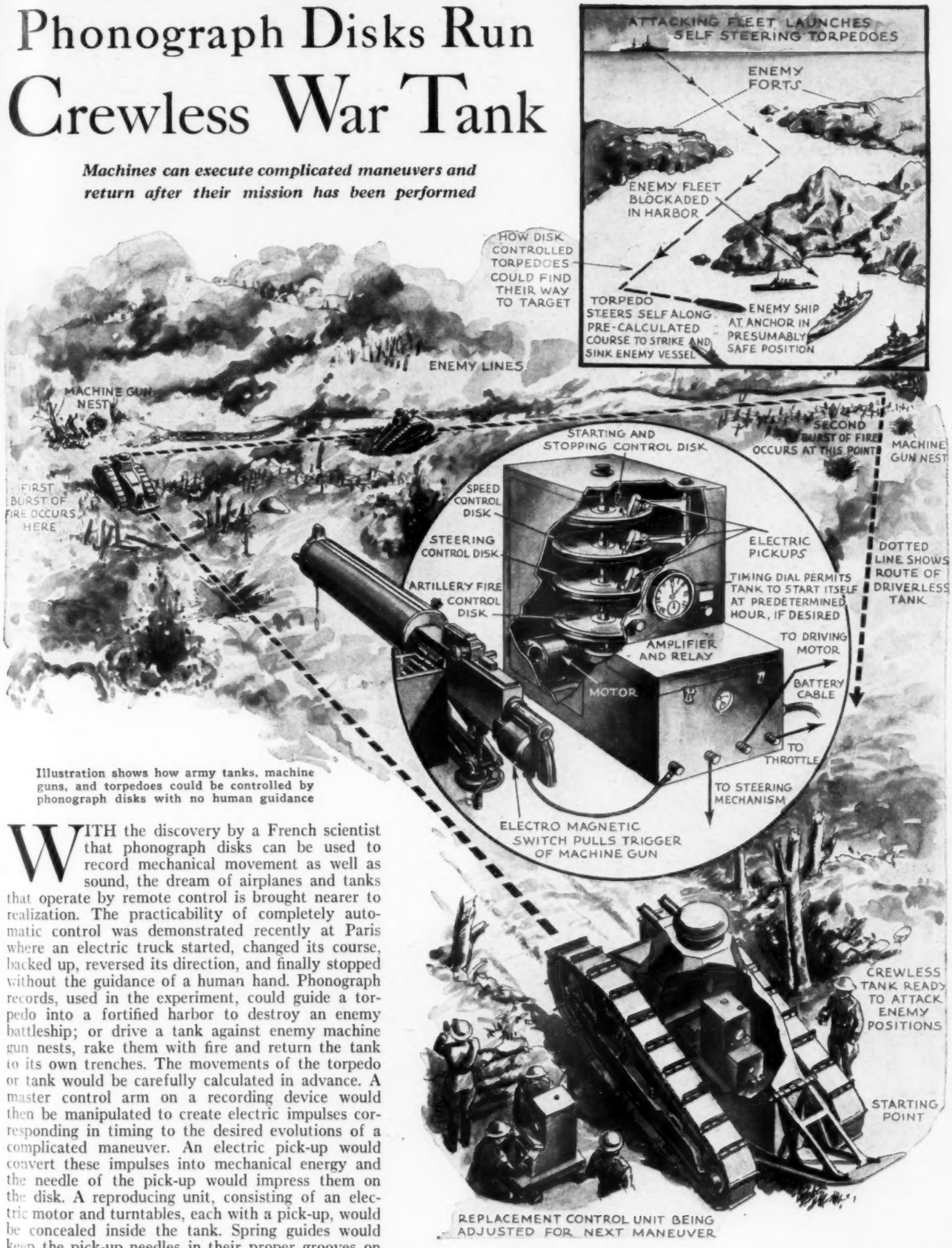

ATTACKING FLEET LAUNCHES SELF STEERING TORPEDOES
ENEMY FORTS
ENEMY FLEET BLOCKADED IN HARBOR
HOW DISK CONTROLLED TORPEDOES COULD FIND THEIR WAY TO TARGET
TORPEDO STEERS SELF ALONG PRE-CALCULATED COURSE TO STRIKE AND SINK ENEMY VESSEL
ENEMY SHIP AT ANCHOR IN PRESUMABLY SAFE POSITION
ENEMY LINES
MACHINE GUN NEST
FIRST BURST OF FIRE OCCURS HERE
STARTING AND STOPPING CONTROL DISK
SECOND BURST OF FIRE OCCURS AT THIS POINT
MACHINE GUN NEST
SPEED CONTROL DISK
STEERING CONTROL DISK
ARTILLERY FIRE CONTROL DISK
ELECTRIC PICKUPS
TIMING DIAL PERMITS TANK TO START ITSELF AT PREDETERMINED HOUR, IF DESIRED
DOTTED LINE SHOWS ROUTE OF DRIVERLESS TANK
AMPLIFIER AND RELAY
TO DRIVING MOTOR
MOTOR
BATTERY CABLE
TO THROTTLE
TO STEERING MECHANISM
ELECTRO MAGNETIC SWITCH PULLS TRIGGER OF MACHINE GUN
CREWLESS TANK READY TO ATTACK ENEMY POSITIONS
STARTING POINT
REPLACEMENT CONTROL UNIT BEING ADJUSTED FOR NEXT MANEUVER

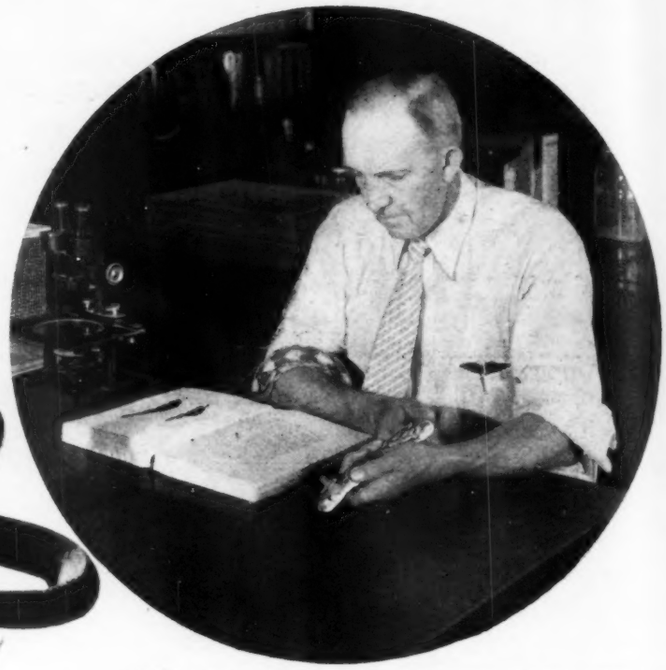
Illustration shows how army tanks, machine guns, and torpedoes could be controlled by phonograph disks with no human guidance

WITH the discovery by a French scientist that phonograph disks can be used to record mechanical movement as well as sound, the dream of airplanes and tanks that operate by remote control is brought nearer to realization. The practicability of completely automatic control was demonstrated recently at Paris where an electric truck started, changed its course, backed up, reversed its direction, and finally stopped without the guidance of a human hand. Phonograph records, used in the experiment, could guide a torpedo into a fortified harbor to destroy an enemy battleship; or drive a tank against enemy machine gun nests, rake them with fire and return the tank to its own trenches. The movements of the torpedo or tank would be carefully calculated in advance. A master control arm on a recording device would then be manipulated to create electric impulses corresponding in timing to the desired evolutions of a complicated maneuver. An electric pick-up would convert these impulses into mechanical energy and the needle of the pick-up would impress them on the disk. A reproducing unit, consisting of an electric motor and turntables, each with a pick-up, would be concealed inside the tank. Spring guides would keep the pick-up needles in their proper grooves on the records. Four disks would be used. One would start and stop the tank and another would steer it. Another record would control the tank's speed and a fourth would aim and fire the machine gun. Detecting the orders carried on the disks, the pick-ups would translate them into electric energy and pass them on to amplifier and relays. Greatly amplified, the current would be carried by cables to electromagnets which would operate the clutch, throttle, and steering gear of the tank and fire the machine gun. A pilotless airplane, similarly equipped, could fly mails across the Atlantic in a few hours. An automatic stabilizer would keep it on a straight course in full flight and a parachute would enable it to land. At a point previously determined, the engine would cut out and the parachute open, bearing the plane safely to earth at its destination.

Fiends *of the* Desert

Animals Long Dreaded by Man Are Studied by Scientist Who Reports Their Poison Seldom Causes Death

By
GORDON GORDON



Above, Dr. C. T. Vorhies with a rattlesnake of whose nature and characteristics he is making an exhaustive study. At left, one of the rattlesnakes, poisonous but always eager to escape

HORROR yarns about the denizens of the desert, spun by cowboys since the days of the Spanish conquerors and accepted by natives and travelers alike as scientific facts, have been disproven by Dr. Charles T. Vorhies, entomologist of the University of Arizona.

Through extensive research which has spanned nineteen years of study on the wastelands of the "sunfire kingdom," he has discovered that the Gila monster, "the blood-spitting dragon of the sands," about which have been woven many fabulous Dracula tales, is not deadly poisonous. Its distant cousin in the lizard family, the horned toad, "the baby dinosaur" of today, is as harmless as a rabbit.

Even the rattlesnake, the very Frankenstein's monster of the mesquite and sage lands, may strike swiftly and with deadly aim but he has found that its poison acts slowly and rarely does a man or woman die if treatment is given. He has also "de-bunked" the coral snake of the Southwest by revealing that while its venom is poisonous, the quantity is too small to kill the average human being.

He has learned that the scorpion, which has ended the lives of many villains in western thrillers, has a sting about equal to that of a common honey bee, and that the tarantula, "hairy monster" of the spider family, seldom bites and when it does, the wound is neither painful nor dangerous. Likewise, his tests have shown that the bite of the centipede is of little consequence.

Cowpunching troubadours, squatting in the eerie shadows cast by campfires, and wizened graybeards crunching hardtack along gold placer streams were the first tellers of these tales of desert terror. Take, for instance, the Gila monster.

Long before the cry of "Gold!" sent the Forty-niners trekking across burning sands, pioneer trail blazers shuddered whenever a Gila (pronounced Hee-la) monster shambled across their paths. The monsters were supposed to be fatally poisonous. They could run, hoary prospectors said, as fast as a horse. They didn't fear any living thing, without provocation would viciously attack a man.

These statements are ridiculous, according to Dr. Vorhies. The Gila cannot run fast and is not vicious unless cornered.

"The Gila monster is the only venomous lizard in the world," he says, "but it is not deadly. There is no authentic record of a human death due certainly to the Gila monster, all stories to the contrary notwithstanding.

"If desert travelers would leave the animals alone, they would never be bitten. I know of no case where a bite has been inflicted except where the victim was teasing the monster.

"They have poison glands in their lower jaws but they have no fangs with which to inject the poison forcibly. If irritated, they will snap and bite, clinging to the victim like a bulldog. Poison may enter the wounds which are made by the small, sharp teeth. The effect naturally varies greatly, depending largely upon the amount of the venomous saliva which flows into the incision. Gila monsters should not be killed. Rather, they should be classed with the road runner and peccary as unique features of the landscape."

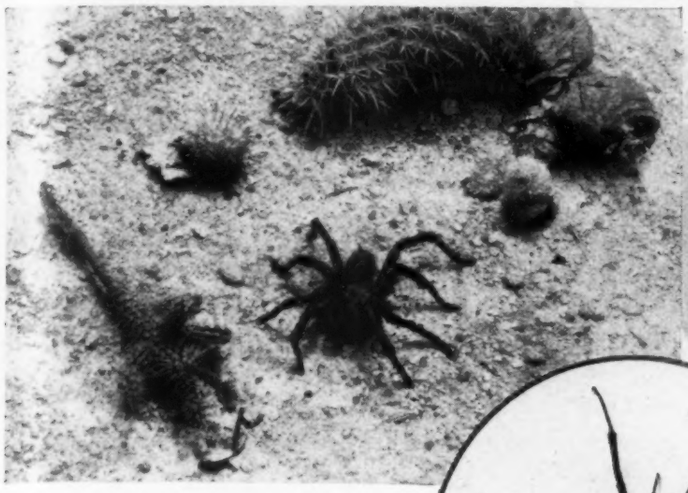
Sometimes the bite of the monster is followed by a swelling of the skin and discoloration but if the wound is treated properly, the victim is able to walk about within a few hours.

While they aren't dangerous to man, the monsters terrorize the desert kingdom. They will even attack the rattle-

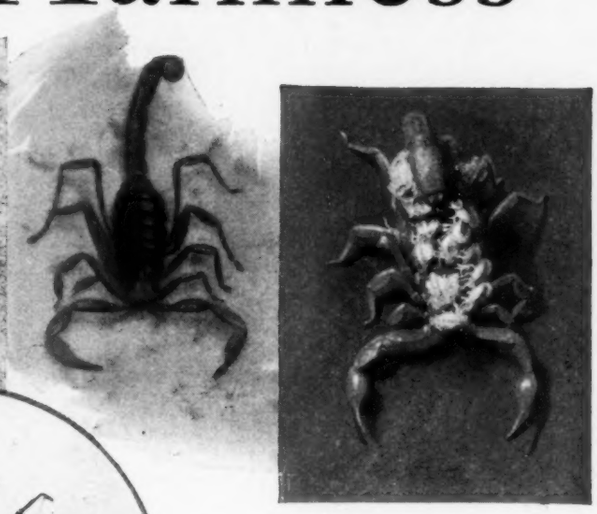
POISONOUS LIZARD AT PLAY

Above, Gila monster jumping from the branch of a low bush while the camera was taking his picture. This lizard is greatly feared but it is far from dangerous. At left a horror-inspiring horned toad that runs away when alarmed by an intruder

Found *to be* Harmless



This tarantula, the size of a teacup, was caught by the camera while sunning itself. This spider is widely feared but its bite is not serious



Above, an unusual picture of a mother scorpion and her babies. They cling to her back and eat her flesh. At upper left, another view of a scorpion. This shows the stinger held ready to attack

The bite of this Black Widow spider is very poisonous and it is one of the desert's dangerous pests

This Smoki Indian of Arizona is apparently defying death while performing a tribal snake dance. The snake, however, is a harmless, non-poisonous bull snake

snake, the "king" of crawling creatures. Range riders occasionally find the bodies of a rattler and monster locked in the grips of death. The monster is usually able to sink his teeth into the snake but before the big reptile dies, he manages to stab several fatal strokes through the tough skin of the lizard. And so, the one perishes within a few minutes of the other.

The monsters vary from one to two feet in length. They are hatched from eggs and are discarded by the mother at birth. They look like a beaded hand bag, their bodies being marked by yellow and orange designs on black. The skins are tough, enabling them to crawl over the thorniest of cacti, using feet that look like small human hands.

The University of Arizona imprisons its specimen Gila monsters in small compartments, like pig pens, where their life histories are traced. So friendly do some of the big lizards become with attendants that they are willing to have their heads rubbed in doglike fashion, although those wishing to pet them are few. The monsters enjoy eggs more than a small boy does ice cream, gobbling them up regardless of whether they are hard-boiled, raw, or still in the shell.

While much observation work has been accomplished, which has revealed the habits of the monsters, more important in a practical way to mankind has been Dr. Vorhies' study of actual cases where men, women and children have been bitten. Many Arizona physicians over almost two decades have coöperated with him in reporting the appearance of wounds, the sufferings of patients, and the time required for victims to recover. Through an intensive survey, which covered every known case where death was reported to have followed a Gila monster's bite, Dr. Vorhies failed to find a single one that could be traced directly to the lizard's poison.

Not quite as formidable as the Gila monster but looking for all the world like a baby model of some beast from out of the prehistoric past, the horned toad is feared by the superstitious. They believe that it will bring scurvy diseases to the households it visits. This is another bit of delightful hocus-pocus, colorful but untrue. The horned toad, which happens not to be a toad but a lizard, is so harmless that they are given to youngsters who stage races with them.

Even exceeding the monster in horror myths are those which have cast the rattlesnake in the rôle of a villain. Many of these, too, are fallacies. For instance, the Arizona scientist has discovered that:

The rattlesnake's poison acts slowly.

Removal of the fangs does not render the rattler harmless.

The snake does not coil to strike.

The rattlesnake cannot leap.

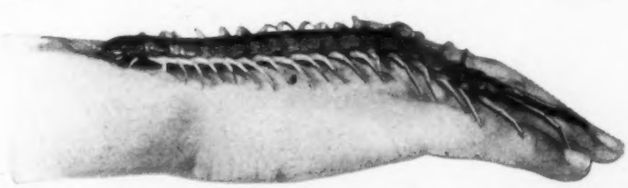
The number of rattles does not indicate with accuracy the age of the reptile.

Whisky is not a remedy for the bite.

"All rattlesnakes are venomous and dangerous; let there be no mistake about that," Dr. Vorhies warns. "The white man should leave the manipulation of live rattlers to the Hopi Indian snake priests who are seemingly much wiser than we in the matter of remedies. But only a small percentage of the bites is fatal. And very few bites are quickly fatal. There is ample time for treatment. Death seldom results before eighteen to forty-eight hours have passed.

"The rattlesnake stabs

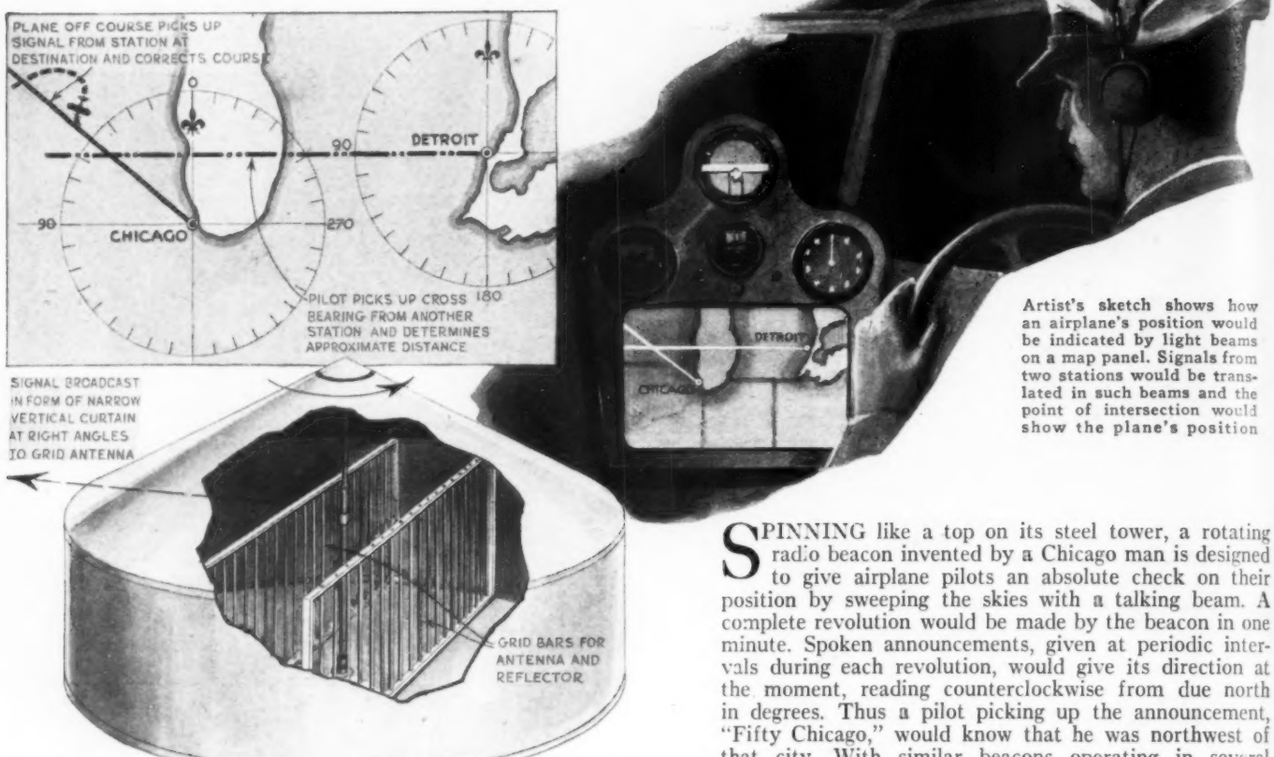
(Continued on page 124)



As this picture shows, the centipede can be trusted to walk over the hand. Unless it is grasped, it will not do any harm

Talking Beacons for Planes

ROTATING BEAM WOULD GIVE BEARINGS


PLANE OFF COURSE PICKS UP SIGNAL FROM STATION AT DESTINATION AND CORRECTS COURSE
0
90
DETROIT
90
CHICAGO
270
180
PILOT PICKS UP CROSS BEARING FROM ANOTHER STATION AND DETERMINES APPROXIMATE DISTANCE
SIGNAL BROADCAST IN FORM OF NARROW VERTICAL CURTAIN AT RIGHT ANGLES TO GRID ANTENNA
GRID BARS FOR ANTENNA AND REFLECTOR
PHONOGRAPH PICK UP ROTATES WITH TOP AND PASSES COMPASS DIRECTION TO TRANSMITTER IN SPOKEN WORDS
SINGLE TRACK RECORD OF COMPASS DIRECTIONS (Corresponds to Compass Card and Directions)
BATTERIES
TRANSMITTER
MOTOR ROTATES INVERTED TOP CARRYING DIRECTIONAL ANTENNA ONE REVOLUTION PER MINUTE
AUXILIARY GAS ENGINE AND GENERATOR SUPPLIES POWER IN EVENT OF REGULAR POWER FAILURE

Artist's sketch shows how an airplane's position would be indicated by light beams on a map panel. **Signals** from two stations would be translated in such beams and the point of intersection would show the plane's position

SPINNING like a top on its steel tower, a rotating radio beacon invented by a Chicago man is designed to give airplane pilots an absolute check on their position by sweeping the skies with a talking beam. A complete revolution would be made by the beacon in one minute. Spoken announcements, given at periodic intervals during each revolution, would give its direction at the moment, reading counterclockwise from due north in degrees. Thus a pilot picking up the announcement, "Fifty Chicago," would know that he was northwest of that city. With similar beacons operating in several cities, a pilot would be able to ascertain his exact position, using cross-bearings from two or more stations. According to the inventor, L. J. Lesh, aviation pioneer, the new system would enable a pilot to detour from the present-day range beacons, which are restricted to narrow lanes. A further development of his system foreseen by the inventor is an indicating panel for airplanes which would flash beams of light across a map corresponding to the bearings received by radio. The point at which two such beams intersected would represent the position of the plane and prevent loss of bearings.

HAMMER FOR STAPLES IS LIKE PISTOL

A NEW rapid-fire staple hammer looks and works like an automatic pistol. With the grip of the device held in one hand, the trigger is pressed to drive the staple into place. The pressure releases a spring-loaded plunger in the device which drives the staple home at one blow. The tacks come in continuous clips of fifty.

STEERING WHEEL FOLDS IN CRASH

DESIGNED to remove one cause of injury in automobile accidents, a new safety steering post collapses like a telescope when a driver is thrown forward by the impact of a collision. The post is constructed of three sections, the one beneath the wheel telescoping into the section below. A coil spring in the second section normally maintains the wheel at its proper height. When the wheel is suddenly depressed, this spring absorbs the shock. The sections cannot turn one within the other.

A lever creates strong suction in this vacuum cup

LEVER GIVES STRENGTH TO SUCTION CUP

FIRM support for a temporary shelf or display rack is afforded by a new suction cup just introduced in this country from Austria. The cup clings so tenaciously to glass or other smooth surface that it will support surprising weights for indefinite periods. The extraordinary suction is made possible by a vacuum built up within the cup by means of a lever. When the device is pressed against a window, a rubber diaphragm lies flat against the glass. By depressing the lever contained in the back of the cup, this diaphragm is drawn back from the glass, creating a vacuum. The cup is removed by raising the lever.

The Man *with the* Net

EVERY TIME *a ship visits the lonely island of Tristan da Cunha, in the South Atlantic, all the 167 inhabitants catch cold. Germs left by the ship's passengers produce the epidemic.*

ONE-FOURTH *of all our muscles are in our face and neck.*

TWENTY-FIVE *million dollars worth of fertile soil was carried by winds from Texas to Nebraska in one year.*

EVERY TIME *a 'phone rings in the United States, an auto travels ten miles.*

THE CHANCES *of being hit by a falling meteorite are so slight that in a state the size of Kansas only one person would be struck in 14,000 years.*

THE PHOSPHORUS *in three old-style matches is sufficient to kill an adult. Yet the human body contains enough free phosphorus to make 800,000 similar matches. Why it doesn't kill us is a mystery.*

A MEDIUM-PRICED *automobile and a porterhouse steak cost about the same per pound.*

GRAINS *of wheat, 4,000 years old, have been found in an ancient tomb and planted near Calcutta, India. The grain differs from any known variety.*

BREADMAKERS *in Berlin, Germany, are keeping loaves fresh by freezing them with dry ice.*

FIFTY-FIVE *shades of nail polish are on sale in one New York department store.*

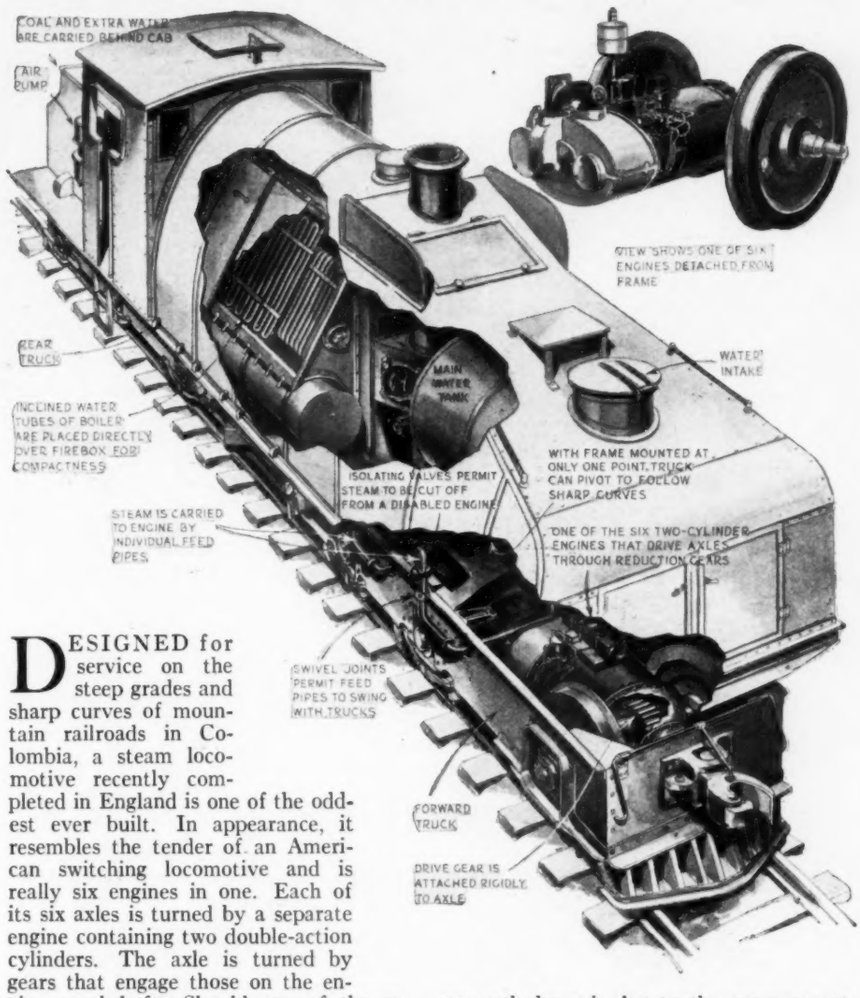
ONE OUT *of every eleven workers in the United States is employed directly or indirectly in the automobile industry.*

A STARVING *woman suffers more than a starving man. A woman's system has been found less able to burn body fats than a man's.*

EACH YEAR, *North American rivers wash 475,000,000 tons of chemicals into the sea.*

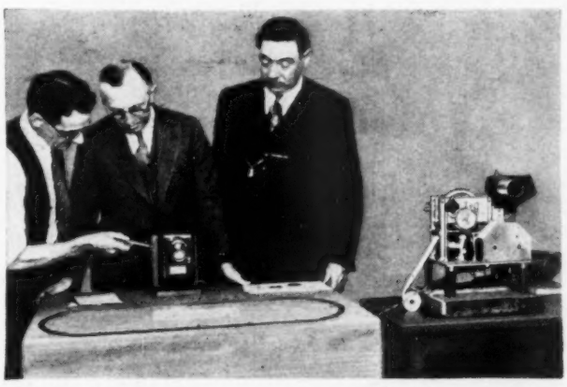
JUICE *from the century plant may be used to prolong human life. Recent tests reveal it is beneficial in treating kidney diseases.*

ODDEST LOCOMOTIVE HAS SIX ENGINES


COAL AND EXTRA WATER ARE CARRIED BEHIND CAB
AIR PUMP
VIEW SHOWS ONE OF SIX ENGINES DETACHED FROM FRAME
REAR TRUCK
MAIN WATER TANK
WATER INTAKE
INCLINED WATER TUBES OF BOILER ARE PLACED DIRECTLY OVER FIREBOX FOR COMPACTNESS
ISOLATING VALVES PERMIT STEAM TO BE CUT OFF FROM A DISABLED ENGINE
WITH FRAME MOUNTED AT ONLY ONE POINT, TRUCK CAN PIVOT TO FOLLOW SHARP CURVES
STEAM IS CARRIED TO ENGINE BY INDIVIDUAL FEED PIPES
ONE OF THE SIX TWO-CYLINDER ENGINES THAT DRIVE AXLES THROUGH REDUCTION GEARS
SWIVEL JOINTS PERMIT FEED PIPES TO SWING WITH TRUCKS
FORWARD TRUCK
DRIVE GEAR IS ATTACHED RIGIDLY TO AXLE

DESIGNED for service on the steep grades and sharp curves of mountain railroads in Colombia, a steam locomotive recently completed in England is one of the oddest ever built. In appearance, it resembles the tender of an American switching locomotive and is really six engines in one. Each of its six axles is turned by a separate engine containing two double-action cylinders. The axle is turned by gears that engage those on the engine crankshaft. Should one of the engines become disabled, the engineman, through convenient valves, can cut off steam to that unit and proceed on the power of the engines remaining. By using six axles, the tractive force of the locomotive is greatly increased for hill climbing and the weight at any one point on the light Colombian rails is kept at a minimum. Three sets of axles are mounted in each of two pivoting trucks, which permit the locomotive to round curves that would derail one with wheels attached directly to the frame. The locomotive's unusual shape is due to the arrangement of the boiler, water tanks and coal bunkers. Having sloping, transverse tubes instead of a single set placed lengthwise, the boiler is quite short. In front are located the main water tank and an air reservoir of the brake system. Behind the cab is a coal bunker and a second water tank. Another air reservoir is placed at the extreme rear. It is believed that locomotives of this type will prove to be well adapted to conditions in mountainous countries and in many other broken parts of the world.

ELECTRIC EYES CLOCK RACE HORSES



Model showing how the new system would time race horses. Photo-electric cells at the track would clock the passing racers

EQUIPPED with photo-electric cells, a new horse-race timing device notes the speed of the horses as they swing around a track and makes an automatic record of the time. The electric eyes are located at intervals along the course. When a horse runs past, cutting off the light from a lamp on the opposite side of the track, the interruption is noted instantly on the tape of the recording machine so time is recorded.

ELECTRIC HEATERS KEEP FISH WARM

Below, thermostat and two 600-watt immersion heaters used to heat water in fish pond at right

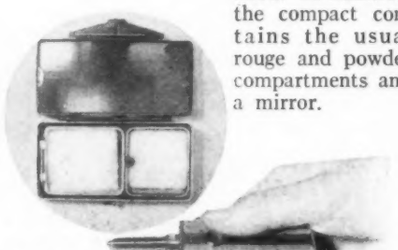
To PROTECT water plants and tropical fish in his outdoor lily pond from the chill of autumn nights, an Angola, N. Y., man warms the water by electricity. Four waterproof heating units, attached to two lengths of pipe, are submerged along the sides of the ten-foot pond. A thermostat, housed in a metal cabinet above the surface, keeps the water at a constant temperature of seventy-five to eighty degrees in any except the most severe weather. Both flowers and fish are thus able to withstand outdoor temperatures that otherwise would be fatal.

LIGHT GIVES TURNSIGNAL

WITH an illuminated direction signal for trucks, introduced recently in England, a driver can warn following cars of every movement he intends to make. Contained in the two top panels of the signal are the registration number of the vehicle and a red tail light. When the brakes are applied, the word "stop," located beside the tail light, flashes on. Before a turn to right or left, a panel below lights up.

DOOR KEY IN COMPACT

WHEN a button on a new compact is pushed forward, a door key slides out. The key is returned to its place in the case by drawing back the button. Another key may be substituted easily whenever desired. In addition, the compact contains the usual rouge and powder compartments and a mirror.



Views of compact that holds door key

This oldest "ear of corn" is not corn but was made of baked clay by an ancient worker in Peru

OLDEST "EAR OF CORN" MADE OF BAKED CLAY

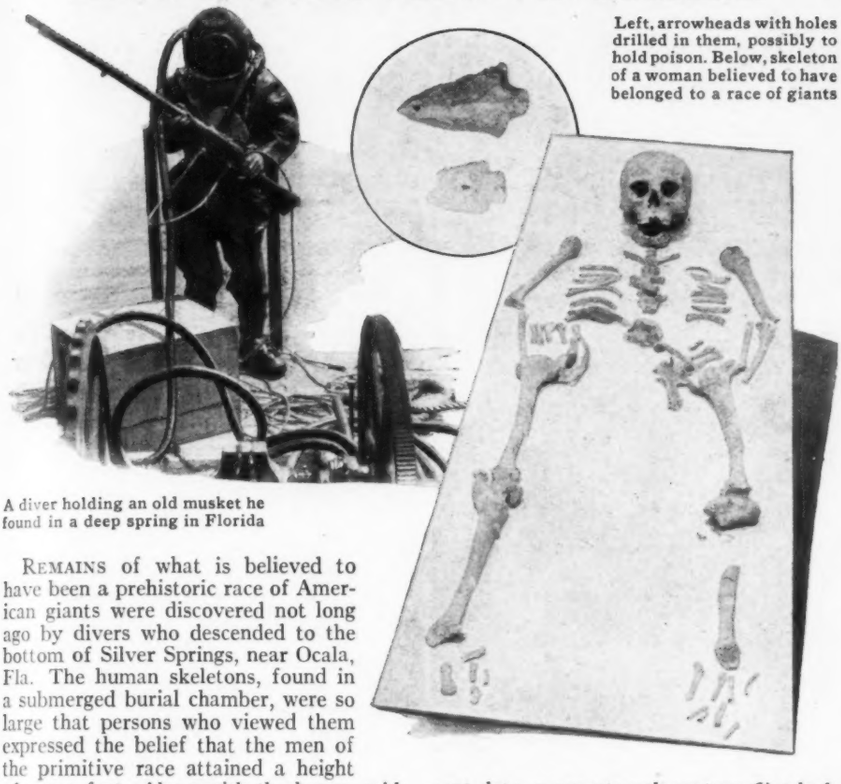
AN OBJECT regarded as the oldest ear of corn on earth, displayed by the Smithsonian Institution at Washington for twenty years, has turned out to be a clay rattle. The relic was bought in Peru and was exhibited in the museum as evidence that maize was grown by ancient Peruvian Indians. Not until a specialist, tracing the history of maize, examined the ear was its genuineness suspected. Upon investigation it was found to be made of baked clay, with a conical cavity at one end containing three small pellets. Its exterior had been expertly fashioned by some skilled artisan of an early epoch to resemble the kernels of corn. Despite the discovery that the ear is not fossilized corn, scientists still regard it as important, since it shows that the Indians of Peru were familiar with maize centuries ago.

Tool Making is Hobby of Noted Inventor and Machinist

George W. Bowers, Somerville, Mass., well-known inventor and machinist, is seen in his shop working at his favorite hobby of making fine tools

A LIFETIME spent as a machinist and inventor has not dampened the tool-using interest of George W. Bowers, of Somerville, Mass. At the age of seventy-three, he still finds enjoyment and relaxation in his home workshop. Recognized as an outstanding expert on machines, he has invented scores of tools and apparatus used in manufacturing watches, scales, phonographs, and firearms. During the World War, England employed fine gages made by him in the manufacture of arms. For more than twenty years, he operated his own business in Boston as a mechanical and consulting engineer, retiring a few years ago from active service. His interest in tools, which dates from boyhood, led him to continue his technical training at night school and by home study after he graduated from public schools, and to find his life work in the field of inventing. It still gives him pleasure as a hobby pursued in his Somerville workshop which is thoroughly equipped with everything necessary to his hobby.

GIANT'S BONES FOUND IN FLORIDA



Left, arrowheads with holes drilled in them, possibly to hold poison. Below, skeleton of a woman believed to have belonged to a race of giants

A diver holding an old musket he found in a deep spring in Florida

REMAINS of what is believed to have been a prehistoric race of American giants were discovered not long ago by divers who descended to the bottom of Silver Springs, near Ocala, Fla. The human skeletons, found in a submerged burial chamber, were so large that persons who viewed them expressed the belief that the men of the primitive race attained a height of seven feet. Along with the bones, said to have lain undisturbed for 2,500 years, were discovered many tools, weapons, and ornaments. Among the finds were clay pots and idols, bone needles, flint arrowheads, and fragments of jewelry. The springs also yielded one relic of more recent date, a seventeenth-century flint-lock musket that may have been used by a Spanish explorer. A search for mastodon fossils (P. S. M., Oct. '33, p. 41) led to the discovery of the human remains as exploration was continued in the depths of the springs.

SPRAYS POWDER ON PUFF

WHEN the plunger is pressed on a new face powder container, the right amount of powder for one make-up operation is sprayed on a puff. The plunger expels the powder in a fine mist, much as an atomizer sprays liquid. The stream of powder is easily directed where it is wanted. When carried in this container, powder is kept from sifting through the other contents of a handbag, as it sometimes does when an ordinary compact is used.

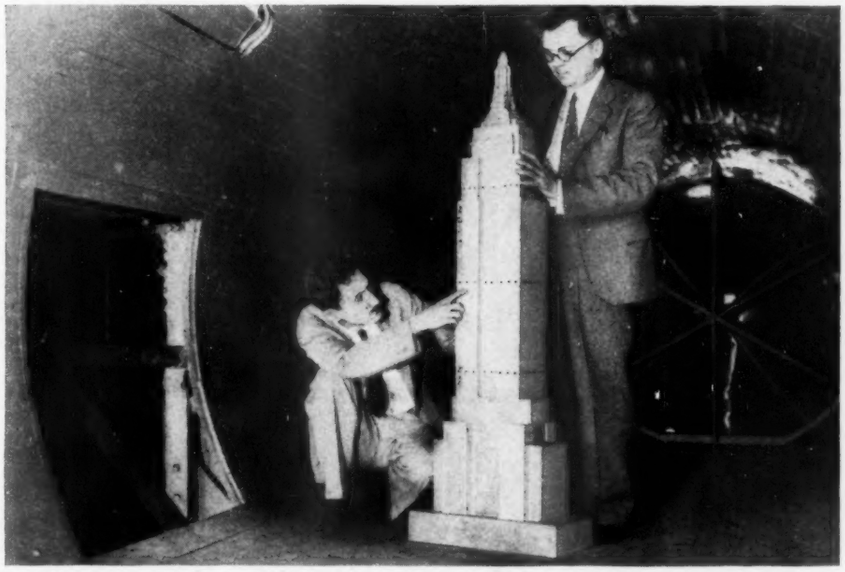
PLANE POISONS LOCUSTS

LAYING down a smoke screen of poison dust was the method of fighting locust swarms tried out in Rhodesia, Africa, recently. Fine sodium arsenite was scattered from a huge tri-motored plane just ahead of the flying insects. The dust formed deadly clouds that killed the locusts.

COURTROOM MODEL SHOW HOW ACCIDENTS HAPPEN

SO JURIES can easily watch the demonstration of traffic accidents, an inventor has developed a board that displays the details of the mishap in a vertical position. The model vehicles, traffic control devices, and human figures used on the board are fitted with long push pins which permit them quickly to be fixed in place. Curb lines of the streets are indicated by flexible tape drawn about removable push pins. The tape is contained in six reels which automatically rewind.

Vertical model for explaining auto mishaps



Model of the Empire State Building being placed in wind tunnel for study of stress in a gale

TEST SKYSCRAPERS IN WIND TUNNEL

SCALE models of famous skyscrapers are now being subjected to the same sort of air-tunnel tests that showed engineers how to reduce the air resistance of airplanes and automobiles. The tests are being conducted at the U. S. Bureau of Standards, Washington, D. C., where experts are seeking methods of lessening the stresses that high winds place upon the steel skeletons of buildings. These stresses are sufficiently powerful to rock tall buildings. The top of the Empire State Building sways a distance of six inches, and the Chrysler Building, about two hundred feet shorter, bends about five inches. Streamlining has been suggested as a possible solution to the problem presented by wind pressure in future skyscrapers.

Mysterious Lost Rivers

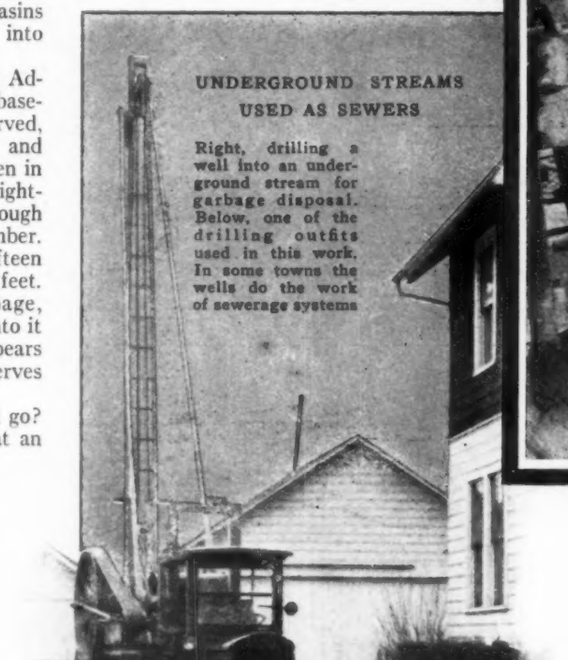
RUN MILLS AND POWER PLANTS

DRILLING garbage wells is the strange occupation that George Adkins of Bellevue, Ohio, has been following for more than twenty years. To all appearances his work is no different from that of any other driller; but he makes no effort to strike water, gas, or oil. Instead, he endeavors to tap the mysterious caverns and streams that lie beneath the city. Into this unseen disposal plant that Nature created goes the sewage from Bellevue's homes and business places. Even the rainwater that flows into catch basins along the streets is conducted into underground crevices.

In establishing a garbage well, Adkins digs, in the back yard or basement of the property to be served, a reservoir several feet deep and about three feet in diameter. Then in the center of this, he sinks an eight-inch pipe until his drill breaks through the roof of an underground chamber. The pipe may go down only fifteen feet, or it may go three hundred feet. Household sewage and garbage, dumped into the pit or carried into it by pipes from the house, disappears forever. Usually a single well serves one or two houses.

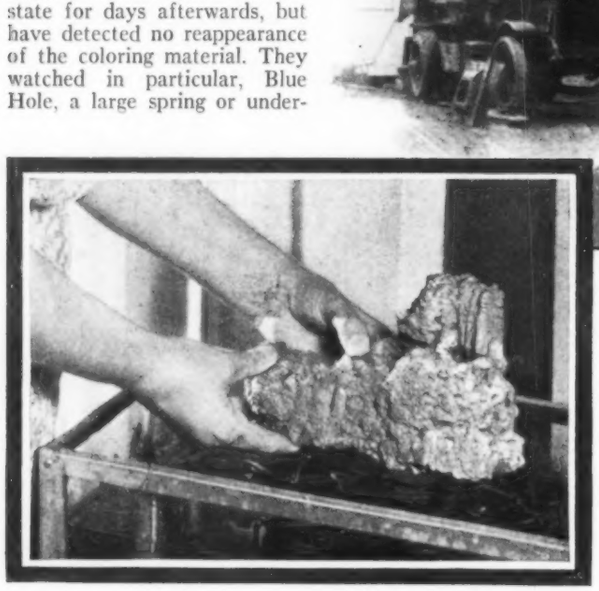
Where does the waste material go? No one knows. It is believed that an underground stream carries the sewage away, but efforts to trace the course of this stream during the past quarter of a century have failed. Investigators have dropped dye into the wells, and then have watched the outlets of underground streams in that section of the state for days afterwards, but have detected no reappearance of the coloring material. They watched in particular, Blue Hole, a large spring or underground river outlet at Castalia, several miles away.

The waste material dumped down the garbage wells of Bellevue apparently does not remain to contaminate the surrounding soil. Excellent fresh-water wells have been drilled with success within the city limits. Although the municipal water supply comes from four reservoirs, an emergency 200-foot well was drilled for use in time of drought. One dry summer this well produced an eight-inch stream of pure water for three months.



UNDERGROUND STREAMS USED AS SEWERS

Right, drilling a well into an underground stream for garbage disposal. Below, one of the drilling outfits used in this work. In some towns the wells do the work of sewerage systems



Rock like this is deposited by mysterious underground waters

Bellevue's sewerage system is one of the most striking uses ever made of the mysterious waterways and caverns that exist beneath many parts of the earth. Perhaps, as you read this, you are sitting above a subterranean river that would rank with many a fair-sized surface stream. Where do these unseen streams flow? What causes them? What influence do they have on surface conditions? Are they of any value? These are a few of the questions that have gained the attention of geologists. Answers have been provided in some cases. But, on the whole, the underground creeks, rivers, and lakes of the United States and the rest of the world remain very much of a mystery.

If you want to find an underground river, look for a big spring. That is a rule based on the fact that, when underground waters emerge into the open air, they sometimes form large springs. A comprehensive survey of large springs in the United States has been made by Oscar Edward Meinzer of the U. S. Geological Survey.

He explains, in a report dealing with these springs, that the question "How big is a large spring?" is not always easy to answer. In a locality where all springs are small, one that produces ten gallons of water a minute would be called large. A spring producing one cubic foot of water a second, or 448 gallons a minute, might be called exceptional. Such a spring is said to have a flow of one second-foot. In one day it would produce 646,000 gallons of water. Yet there are springs in this

How Subterranean Waters Are Found and Put to Industrial Uses Is Graphically Described in This Very Unusual Article

By WALTER E. BURTON

Twelve miles above Opal Spring, Ore., Crooked River is practically dry, as shown in the picture at the upper left. Five miles below the town, it has a large flow of water, mostly derived from large springs which come from underground rivers

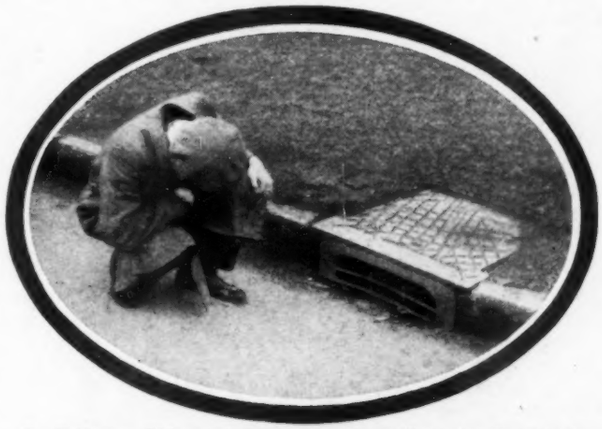
Underground streams that come to the surface near the top of a cliff form this beautiful cascade at Thousand Springs, Idaho. The photograph shows only a part of the falls, to which thousands of sightseers are attracted

country that are rated at more than 800 second-feet. Such a spring could supply water for a city of nearly 5,200,000, assuming that each person uses 100 gallons a day. There are, according to Meizner, about sixty-five different springs in the United States that could supply enough water for the needs of Washington, D. C., and several that could provide the water for New York's millions.

In northern and central parts of Florida, and near-by parts of Georgia and Alabama, are found some of the largest springs in the country. Streams large enough to be navigated by fair-sized passenger boats are produced by single springs in this section.

The Florida springs are of the limestone type. They are fed by water flowing in subterranean passages through the limestone that underlies the sandy soil. These passages have been made large by centuries of use, so that the water passes through them rapidly enough to make possible the enormous flows recorded. Because of its rapid passage, the water in these underground streams does not dissolve much mineral matter. In reaching the subterranean streams from the ground above, the water is filtered through layers of sand that remove nearly all solid particles, so that the spring water is remarkably clear. Silver Spring, the largest in Florida, as well as various other large springs in the region, is interesting to visitors because of the high transparency of its water, which permits fish at great depths to be seen plainly through glass-bottomed boats and from the shore. There are more than thirty species of fish in the spring, and they are so tame that they will eat from one's hand. The Florida springs are more interesting to the visitor when he knows that they are caused by the emerging of mysterious underground streams.

Sometimes a surface stream transforms itself into an underground stream, and causes people to give it some such name as "Lost River." The Wakulla River system in Florida, involving beautiful, punch-bowl-shaped Wakulla Spring, makes use of subterranean channels. Several streams originating near the Ocklocknee River in Leon County flow southeast until they reach the limestone region. There they disappear into the ground through sinks. Occasionally the courses followed by the subterranean streams are marked by sinks caused by caving in of the earth above them. In Wakulla County, for example, River Sink affords a view of the underground stream. Finally, part or all of the underground rivers that started out as surface streams emerge to form Wakulla spring, and then continue to the Gulf as the surface-going Wakulla River.



In Bellevue, Ohio, even the water that collects in the streets is carried away by the underground streams that form the city's sewerage system. The drains are like those used in other cities

In Alabama are a number of underground streams and lakes that give rise to springs. In soft rock strata of some mountain sides are immense caves that contain beautiful stalactites and stalagmites, or limestone icicles. Nearly all of these caves contain streams of running water, and some have large springs. A few lead to subterranean lakes.

In Morgan County, Alabama, is a mill stream noteworthy because it is entirely underground. In a two-mouthed cave, a subterranean creek emerges in the form of a spring, and then flows sixty or seventy feet to the site of an old mill. The water was dammed up, when the mill was built, by piling rocks across the creek in the larger of the cave mouths. Thus the old mill pond is entirely subterranean.

Mammoth Spring in Arkansas affords an example of how underground waters can be harnessed for useful purposes. This spring, *(Continued on page 116)*

Magician Hides His Garden Lights

Inside this bird house a light is concealed to furnish indirect illumination for a California garden. Below, an imitation toadstool used as light fixture

This view shows a Pasadena, Calif., garden as it appears at night when it is fully illuminated with lights that are cleverly hidden in bird houses or under umbrellas

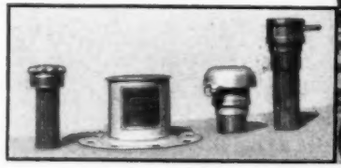
A RETIRED stage magician of Pasadena, Calif., has found a way to illuminate his garden at night without cluttering up the place with standards, fixtures, and wires. The lights are concealed in bird houses, under lawn umbrellas, and in trees and shrubs. Wires are carried underground to strategic points about the garden whence they emerge in the form of natural-looking imitation toadstools, containing outlets for the plugs of the light cords. In daylight, the birdhouses and other fixtures blend naturally with the garden setting. Even at night the source of light is difficult to detect. One of the lights developed by the inventor sheds a glow resembling moonlight. Another, contained in a water-tight bronze case, can be used beneath the water of swimming pools. He has also developed a system of shadowless lighting by means of which tennis courts can be illuminated so that play at night can be indulged in with as much satisfaction as during the day. In some respects this artificial lighting is superior to sunlight.

NEW REFLECTOR TRIPLES LIGHT OF AIR BEACONS

LIGHT from an airport beacon has been given three times its normal intensity by a U. S. Bureau of Standards expert. To accomplish this, he mounted a simple auxiliary reflector in front of the lamp of a standard twenty-four-inch rotating beacon and substituted plain glass for the usual prismatic cover. The reflector catches stray light and throws it back upon the main reflecting mirror. The plain glass cover keeps the reflected light concentrated within the beam. At one time, 1,000-watt lamps were used in the beacons, but as an economy measure 500-watt lamps were substituted some time ago. It is planned to place the reflectors and plain glass covers on all beacons.

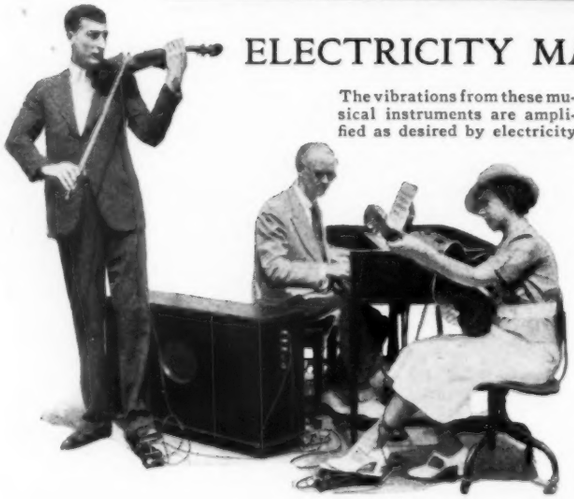
GUARDS GAS TANK FROM FIRE

EXTERNAL flames are prevented from entering gas tanks and pipe lines and causing explosions by a recently invented safety device. The device contains a series of wire screens that permit the escape of fumes and the flow of liquids, but offer an effective barrier to flame. The ability of the appliance to prevent an explosion was demonstrated when fumes, escaping from a tank equipped with the attachment, were ignited. Gasoline burned but no fire passed into the tank.



At far right two of the anti-explosion devices that keep flames out of gas tanks. At right, types of caps for tanks

ELECTRICITY MAKES MUSIC

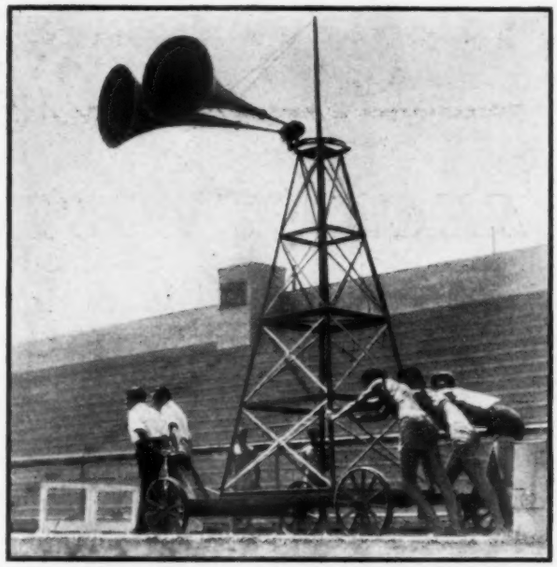


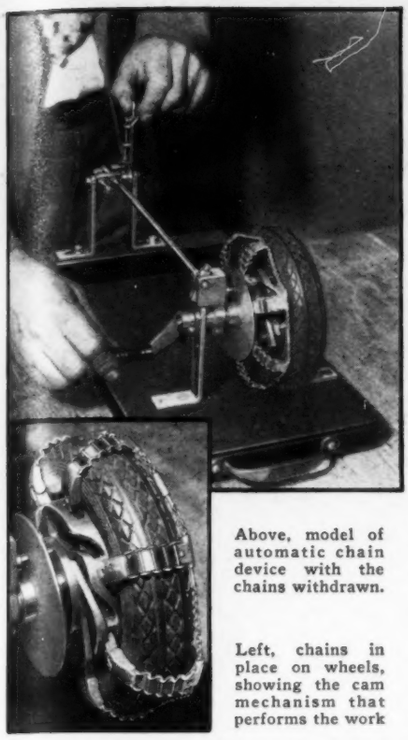
The vibrations from these musical instruments are amplified as desired by electricity

THREE new musical instruments, a guitar, a violin and a clavier, recently invented by Lloyd Lear, lecturer on the physics of music at Northwestern University, Illinois, produce their music electrically. The unusual instruments have no sounding boards and the strings when struck vibrate with little sound. The vibrations are caught by electric pick-ups and converted into current. Then the impulses are converted into music.

LOUDSPEAKERS REPORT FOOTBALL PLAY

SPECTATORS at football games played by the Venice, Calif., high school team are kept informed of yards gained and penalties inflicted by means of a loudspeaker system designed and built entirely by students. Carrying microphones, student observers move up and down the sidelines and relay information to an announcer. The system was first installed in the school auditorium and, when this was wrecked by an earthquake, all available parts were salvaged and the system adapted to outdoor use on the athletic field now also doing service as an auditorium. For announcing athletic contests, the speakers are mounted on a tower.





Above, model of automatic chain device with the chains withdrawn.

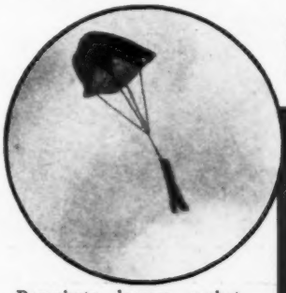
Left, chains in place on wheels, showing the cam mechanism that performs the work

AUTOMATIC DEVICE PUTS CHAINS ON AUTOMOBILE

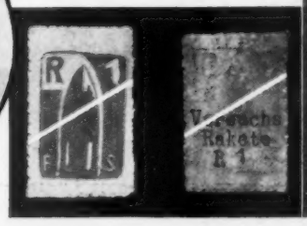
AUTOMOBILE chains are attached or removed by a new automatic device, without need for the driver to leave his seat. The operating part of the device is attached to the rear brake drums. Arms radiating from a metal ring that encircles the axle shaft, carry the chains. When a control lever is pulled back and the car backed, these arms move through grooves in a cam, rising and tilting forward. This movement clamps the chains firmly over the treads of the tires. When the lever is pushed forward and the car runs ahead, the supporting arms fall back into place and withdraw the chains.

MAIL SHOT IN ROCKETS

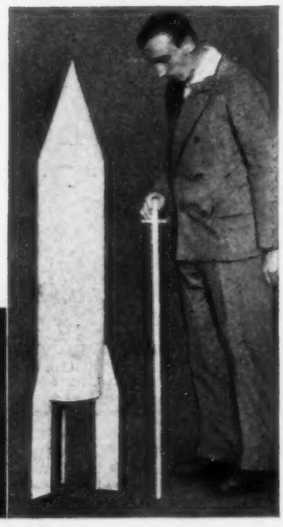
SO SUCCESSFUL were Austrian experimenters in shooting mail through the air with rockets, in recent trials, that every piece of mail was delivered safely. The distance traversed was two and one half miles. Invented by a young Austrian, the rockets contain parachutes which open to lower the rocket.

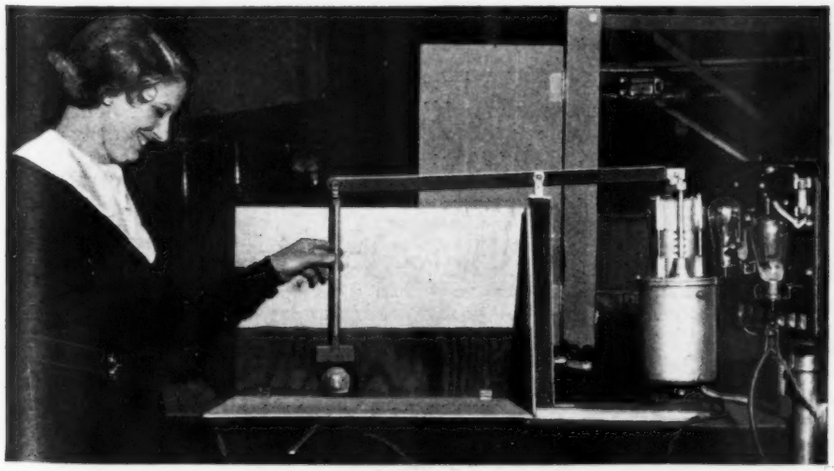


Parachute lowers rocket with mail at destination



Right, one of the mail rockets used in recent tests in Austria. Below, a special stamp issued by the government for the trial





ELECTRIC EYE OPERATES MOUSE TRAP

A PHOTO-ELECTRIC cell is employed as the actuating principle in a novel mouse trap constructed recently at an engineering school in Milwaukee, Wisc. The device is so placed that a ray of light passes across the front of the mouse hole. Above the hole, a heavy hammer is suspended on a lever operated by an electromagnet. When the rodent emerges, he intercepts the ray of light and the electric eye causes the hammer to descend with a pressure of 200 pounds. It is reported that tests have shown the device to be highly effective in destroying the pests.

LINEMAN'S SPUR MAKES FAST BEAN POLE SETTER

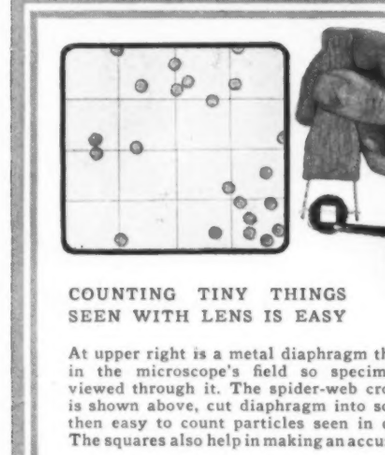
TO SPEED up the work of setting bean poles, an Oregon gardener has made a tool from a lineman's pole-climbing leg iron. In place of the climbing spur there is a piece of metal resembling an inverted V with the legs bent outward and the lower edges sharpened. The stake is held in one hand and the foot raised so that the sharp edge of the metal V grips the stake. A downward thrust drives the stake into place. In use the iron is attached to the leg as shown in illustration.

Flowers' *SECRET HISTORY* *told by your* Microscope

The minute and hidden parts of a flower, as seen in a microscope, can be placed permanently on paper as is shown below

COUNTING TINY THINGS SEEN WITH LENS IS EASY

At upper right is a metal diaphragm that is placed in the microscope's field so specimens can be viewed through it. The spider-web cross hairs, as is shown above, cut diaphragm into squares. It is then easy to count particles seen in each square. The squares also help in making an accurate drawing



HOW TO STUDY POLLEN

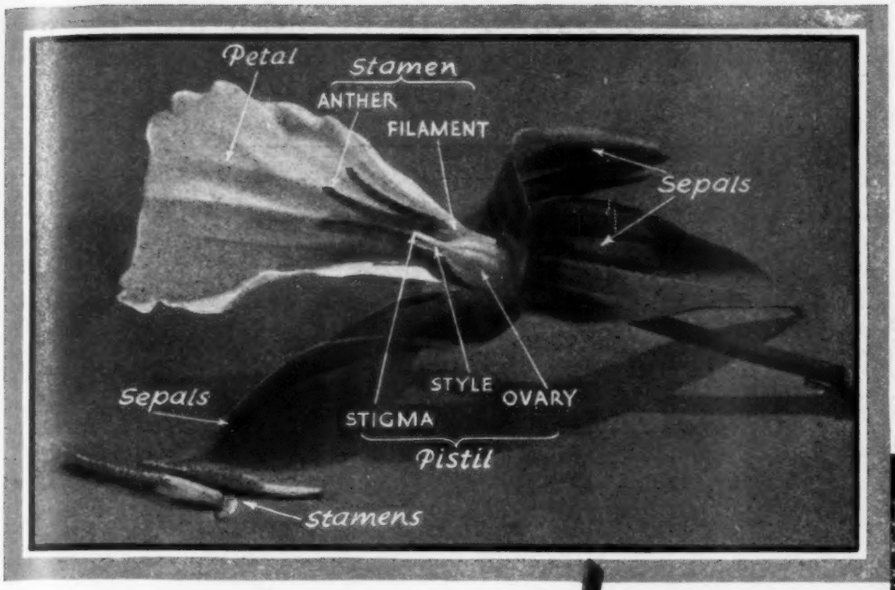
In the illustration at left, pollen of trillium, germinated in cane sugar solution and then put on slide under a lens, appears as shown here. The tubes penetrate the stigma and at last reach ovary

THROUGH spring, summer, and fall, the plants display their works of art. To many persons the flower represents the supreme achievement of the plant on which it grows, the goal towards which all other efforts of the organism are directed. To the plant, however, the flower is merely a means to an end. With your microscope, you can discover this for yourself. In addition, you can uncover hidden beauties far more striking and interesting than those visible to the unaided eye. Your magic lenses will show that many of your ideas about the ways of plants and their flowers have been wrong. For instance, with your microscope you will learn that the seed is not the real beginning of a plant, but only a resting point in a development that has a fascinating beginning farther back in the life story.

There are four parts to the typical flower, and each of these is, in reality, a leaf that has been produced for some special purpose. Beginning at the outside of a peony blossom, for instance, you find first the sepals, green in color and resembling foliage leaves. Together the sepals form the calyx. Next are the petals, whose color and beauty make them the most attractive parts of the blossom. The petals are known collectively as the corolla. In some flowers, the edges of the petals are united to form a tube, or cone-shaped corolla. Next come the stamens, which produce the pollen. Each stamen consists of a filament on the tip of which is a four-compartment anther in which the pollen grains grow. Finally, in the center of the blossom, is the pistil, made up, in the case of the peony, of two carpels. Other flowers may have only one carpel, or many. The pistil consists of three parts, a bulbous base or ovary from which extends a style or stem on the tip of which is a stigma. This stigma usually is covered with hairs or a sticky substance.

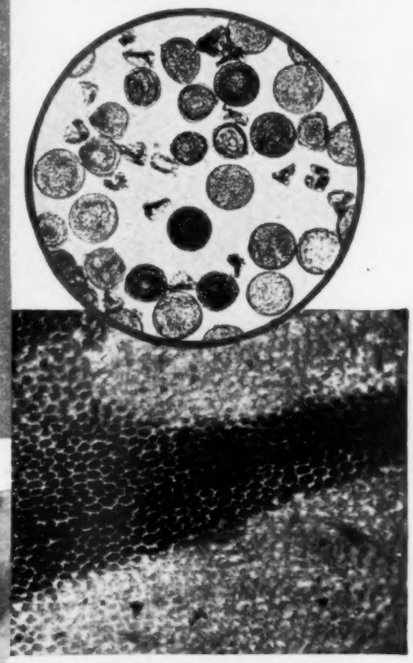
Before you can appreciate the wonderful drama that takes place in the flower, you will have to do a little exploring with your microscope. Pick a few blossoms, any kind that you can find outdoors or in the house, and take them into your laboratory. Lay out several clean slides and cover glasses.

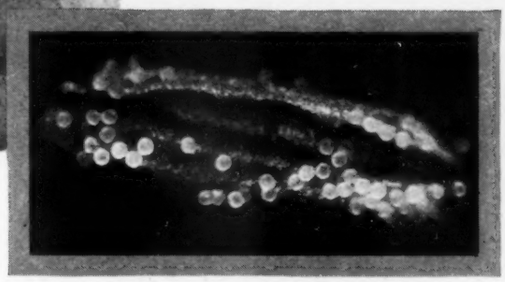
Pick up one of the flowers and hold it with its center over one of the slides, tap the flower sharply with your fingers, so that some of the grains of pollen will fall upon the glass. Transfer the slide to your microscope, and examine the grains. It is impossible to predict just what wonders will greet your eyes, without knowing from what flower you get the pollen. There is an almost unlimited variety of size, shape, and surface construction. Some flowers, like hollyhock, produce pollen grains covered with spines. Others display slits, warts, dimples, facets like a cut diamond, or spiral grooves. The pollen of the pine tree has three lobes, two of which are air-filled bladders that en-



This photograph of a flower from a trillium plant shows the principal parts of a blossom including the sepals, petals, corolla, and the stamen which produce the pollen

Below, in circle, are magnified tulip pollen grains. The irregular particles are dust. Beneath the circle is an enlarged photograph of a pansy petal





Above, view of pollen grains emerging from anther of a wild geranium flower. Upper right, tearing tiny pieces from plant petals to secure suitable microscope specimens

By

MORTON C. WALLING

able it to be carried by the wind. Some pollen grains have sticky filaments.

Why all the variety? You can find the answer by doing a little detective work in the garden or woods. If you ever were in a pine forest when the trees were producing pollen, you can appreciate the usefulness of the little air sacs with which each grain is equipped. The pine, being one of the lower forms of plants, depends upon the wind for carrying its pollen from one tree to another. Therefore it produces pollen in abundance so that the yellow grains literally rain down, filling low spots and crevices wherever they alight, and forming a golden layer on the surface of water. There is great waste in this method, for only a small percentage of the pollen grains reach the flowers of another pine tree.

More highly developed plants do not depend on the wind. Instead, they have entered into a cooperative scheme with the insects and, in some cases, the birds. Many plants have gone so far as to arrange things so that only certain kinds of insects will have the privilege of carrying their pollen from one flower to another. It is to enable them to cling readily to the hairy bodies of insects that certain pollen grains have rough surfaces.

Careful study of a pollen grain will show that it is really a living cell of spore. It is a drop of living protoplasm surrounded by a protective shell. This shell, in some forms, has an inner and outer layer. The protoplasm contains the usual cell nucleus. The pollen grain is in reality a little packet of life that enables the plant to reproduce its kind. It is the male cell that unites with a female cell to form a seed. It is to find such female cells that pollen grains travel, frequently great distances.

If you remove a stamen from a flower and with your microscope, examine the anther at its top, you will find that the pollen grows inside this anther. The shape of the anther varies with different flowers. It usually is rounded, but may be forked or greatly elongated. When the pollen is ready to be distributed, the anther bursts open and the yellow grains emerge through the slits that are easily seen.

Before tracing the travels of a pollen grain, examine the pistil, at the center of the blossom. Under the microscope you can see that the stigma, or bulblike formation at its tip, is equipped for capturing and holding things. Frequently it is hair-covered and sticky. The bulbous base or ovary is a most important part of the pistil. With a sharp knife cut part of it away, exposing the interior. A violet or pansy ovary is an excellent object for examination. Inside it you will find numerous round, glistening bodies that look like tiny pearls nestling in a case. These are the ovules. Inside each ovule is a somewhat complicated arrangement that presents some difficulty when attempts are made to examine it. There is an embryo sac containing yellow-brown protoplasm and a number of cells including the egg cell. Remember this egg cell, for it has an important job to perform.

Now you are ready to follow the travels of a pollen grain from one flower to another. The grain, in some way is carried from the stamen on which it grew to the flower in which it will continue its work. The pollen grain finds the necessary warmth and moisture on the stigma, and starts to germinate or grow. Incidentally this is true plant germination. When a seed is said to germinate it really is merely awakening. As the pollen grain continues to grow, a slender tube moves outward from the inner layer of the sac and penetrates the stigma. Here the pollen grain demonstrates a power that a mere microscopist cannot understand, for the pollen tube invariably grows in the right direction. It moves through the stigma, down the slender style or stem that holds the stigma up where pollen grains can reach it, and eventually enters the ovary where it finds the egg cell of one of the ovules. The pollen tube and egg cell unite, and a new plant is born.

Gradually, by the universal method of cell division, the fertilized egg grows into a tiny embryo plant. In the meantime the outer wall of the ovule has hardened into a tough case that eventually becomes the shell of the seed. After a time growth ceases, and the seed is ready to find some place to grow. So, you see, a seed is really a tiny *(Continued on page 107)*

RAT CATCHERS GET COLLEGE TRAINING

Left, laboratory in use by students at college where rat catchers and professional disinfectors are being trained

Use of new disinfecting apparatus is demonstrated to the students at the unique college

GERMANS who follow the calling of exterminating rats and disease-bearing vermin are now being trained scientifically. The world's first college, devoted exclusively to teaching this work, was opened not long ago in Berlin. The college trains not only recruits but men who have been engaged in the work for years. All students are required to study bacteriology before undertaking to learn the technique of fumigating and rat hunting. On graduation, they will be required to pass an examination before being granted a license to engage in professional work. Methods of disinfecting after the outbreak of infectious disease are included in the training course.

WORLD'S BIGGEST DREDGE PANS GRAVEL FOR GOLD

ONE of the largest machines ever assembled is now being used to dig for gold in the rich placer fields of California. The steel snout of the mammoth dredge sucks up as much gravel each day as could be panned by more than 2,000 men working ten hours a day. The dredge is entirely self-contained, not only digging the gravel but washing it and extracting the free gold. The 15,000 cubic yards of gravel scooped out and washed in a single day would fill a ditch three feet wide, six feet deep, and more than four and one-quarter miles long. The use of such a machine makes the panning of low grade gravel profitable and other gigantic dredges are being constructed and will be used to recover the precious metal.

AZTECS FLEW GLIDERS MANY CENTURIES AGO

GLIDERS were in use thousands of years ago by Aztec Indians, according to a Polish archæologist who has found a design for a glider carved in stone. The glider had wings of stork feathers and was used by an Aztec king in gliding down from the Mexican mountain heights. Pictures of goggles worn by pilots have been found.

BLIND GET BOOK ON TWO PHONOGRAPH RECORDS

LITERATURE of every kind is made available to the blind by the invention of a talking book. Two of the records, one sixteenth inch thick, will record the reading of a novel of average length. Crowding this surprising amount of speech into one of the records is accomplished with the aid of a new speed control device that is used in both recording and reproducing the sound. The device increases the speed of the turntables as the recording or reproducing needle travels toward the center of the record, thus keeping the speed of the needle constant. The new talking book with its remarkable capacity, is expected greatly to reduce the cost of placing the world's literature at the disposal of those who can't read regular type.

LABORATORY MOTHS TEST WOOL FABRICS

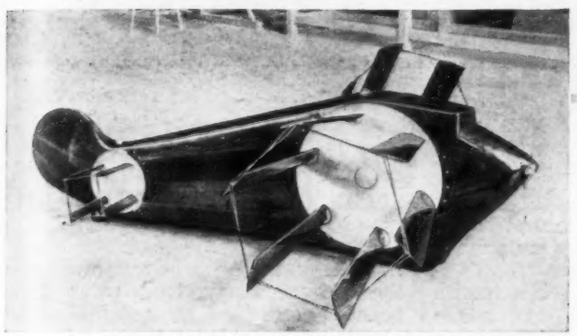
Above, experts examining fabric that moths have attacked. Right, first dish contains treated fabric, the other untreated fabric

ONE of the queerest laboratories in the world has been established at Philadelphia by a woolen mill to test the value of various moth-proofing processes. Instead of guinea pigs, this laboratory keeps thousands of moths locked up. Thermostatically controlled electric heaters keep the room at the right temperature for the moths. The diet of the pests consists of samples of upholstery fabrics which have been treated with moth-proofing materials. Thus the mill tests the various moth-proofing processes. When the supply of necessary moths runs low, the laboratory buys more of them at five cents apiece from boys who capture them.

Paddle Wheels Drive Wingless Plane

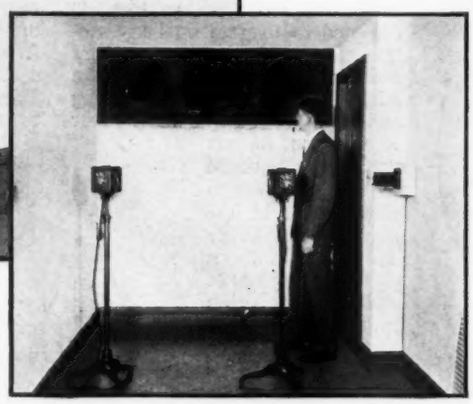
PADDLE wheels take the place of wings, stabilizers, and propeller on a new airplane designed by a University of Washington scientist to permit hovering in the air and slower landing speeds. Revolving vanes in these wheels would propel the plane and control its vertical movements. Two paddle wheels are attached to the fuselage in the position ordinarily occupied by the wings, and two smaller ones replace the stabilizers and elevators near the tail. The larger wheels, or cycloidal propellers as the inventor calls them, have six vanes attached to a revolving disk. Only four vanes are carried by the smaller wheels. In addition to its ability to hover and land at low speed, the new craft, its inventor says, possesses unusual advantages as a fighting ship, having nothing to obstruct gun fire.

At lower left, a seven-foot scale model of the proposed paddle wheel plane. Below, artist's idea of plane in flight

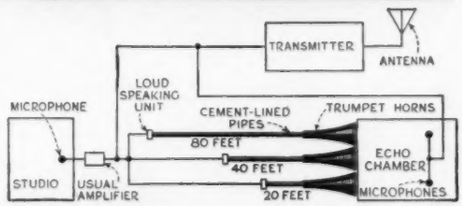


ECHO ROOM GIVES RADIO REALISTIC NOTE

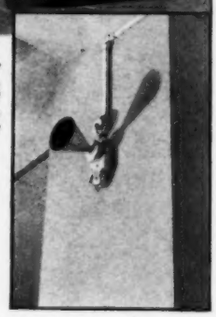
Left, one of the tubes now used in broadcast studio to give echo effect. Below, echo chamber where microphones pick up sound after it leaves the echo tubes



REVERBERATING crashes of thunder or the echoing voices of speakers may now be imitated in a radio broadcasting station. The feat is accomplished at Radio City, New York, by oversized speaking tubes and an "echo chamber." A program is produced in a regular studio and picked up and put on the air in the usual way, with one important addition. During the process, a loudspeaker, facing a speaking tube, reproduces the parts of the program that call for echo effects. Sounds travel along the speaking tube, arriving in an echo chamber after a slight delay representing the time of passage through the tube, and are then picked up by microphones and combined with the original program. The listener, as a result, hears the original sound plus an apparent echo. The system employs three speaking tubes of graduated length. Echoes obtained with the shortest tube resemble those heard in an auditorium of moderate size.



Simplified diagram showing principle of echo system

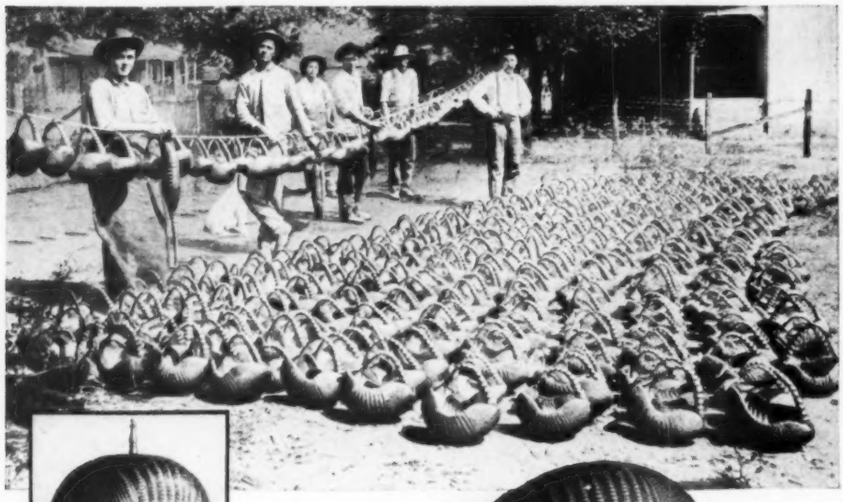


Photos show key and sounder used in new office call system

OFFICE CALL SYSTEM USES MORSE CODE

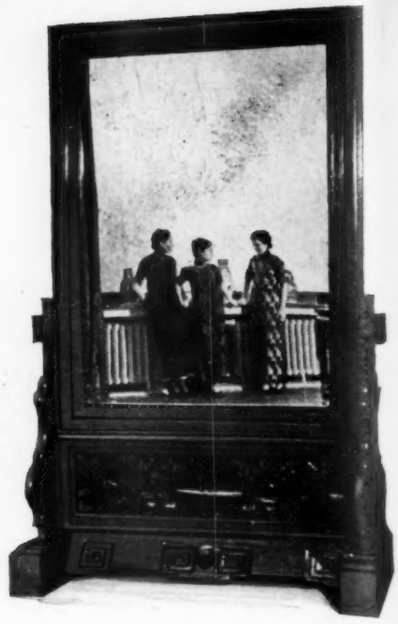
AN OFFICE call system employed by officials in the traffic department of the Western Union Telegraph Company in New York uses telegraph code. Subordinates are summoned by an official merely by tapping out the initials or call letters of employees on a key conveniently placed on his desk. Buzzers located on various columns carry the dot and dash message to all parts of the department. Since most of the employees are familiar with the telegraph code, none has any trouble deciphering the buzzing that to the average person would be wholly unintelligible. On occasion, the private telegraph system is used by officials to hold short conversations over distances up to 100 yards.

ARMADILLOS BRED ON TEXAS RANCH



Above, shells of hundreds of armadillos bred on a Texas ranch. Left, a lamp shade, one of the objects of art made from the shells. Right, armadillo with two young ones

ONE of the most curious industries in existence is conducted by a rancher near Comfort, Texas, who breeds armadillos and from their shells and bony tails makes lamp shades and armadillo baskets. Starting with a few of the creatures and a small plot of ground, he now has a ranch that extends over many acres. The thousands of armadillos bred by him furnish a great part of the shells used in the manufacture of ornaments in this country. Since the animals leave their burrows only at night, their capture is limited to the hours after dark. As many as 250 of the shell producing creatures have been taken in a single night.



MIRROR PROVIDES FRAME FOR TRICK PHOTOGRAPH

A PHOTOGRAPH that appeared already framed was made recently at Moscow in the Chinese embassy. Three wives of embassy attaches were grouped in front of a wide window when a photographer arrived to make their pictures. Their reflections, he noticed, were caught neatly by a heavily framed standing mirror on the other side of the room. Training his camera on this, he got the picture shown.

ODD CRAFT BUILT FOR RAISING SUNKEN SUBS

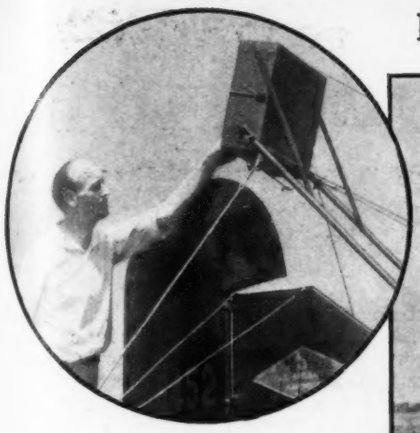
THE difficult job of raising a sunken submarine was accomplished speedily and easily during recent tests of a curious new marine crane in the harbor at Toulon, France. Designed especially for rescue work, the crane's supporting hull is shaped like a huge U. The divided forward sections of the hull support a massive span of steel trusses which carry the lifting machinery. Heavy chains, slung beneath the sunken submarine or attached to hooks on its sides, quickly haul the craft to the surface inside the space enclosed by the crane's hull. A gangplank gives quick access to the conning tower.

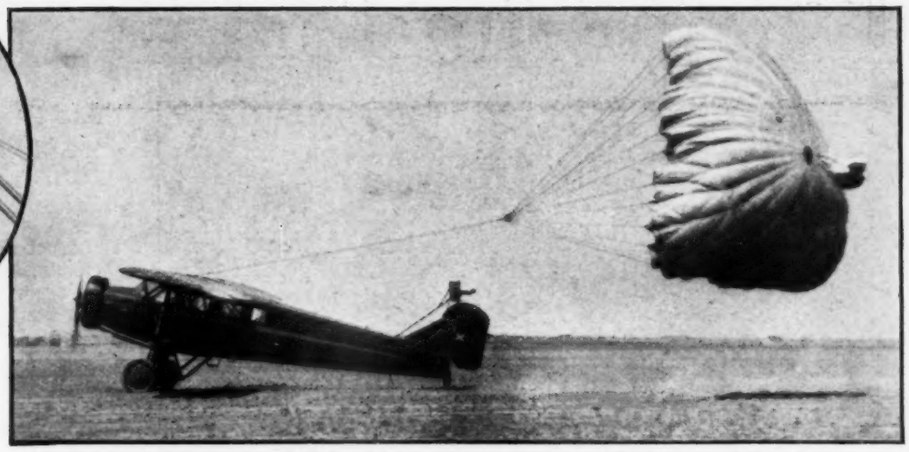
FREAK BIKE RUNS BY MOTION OF BODY

A BICYCLE without pedals, invented by two Chicago men, is designed to operate on body motion alone. Standing on a springy footboard, a rider propels the strange vehicle simply by raising and lowering his body. The rear wheel of the bicycle has its axle mounted off center. A downward thrust of the legs tends, after the bicycle has been placed in motion, to pull this axle down to its lowest position, thus causing the wheel to revolve in a forward direction. Momentum returns the axle to its highest position and the procedure is repeated. The up and down flexing of the footboard, once the rider gets the knack, can be coördinated with the movement of the rear axle to make operation easier. After a little practice, the inventors claim, a rider can make fifteen miles an hour. The exercise is said to be very beneficial to health.

An eccentric rear wheel on this bicycle furnishes the motive power. Movements of the rider's body produce a speed of 15 miles an hour

PARACHUTE BRINGS PLANE TO QUICK STOP



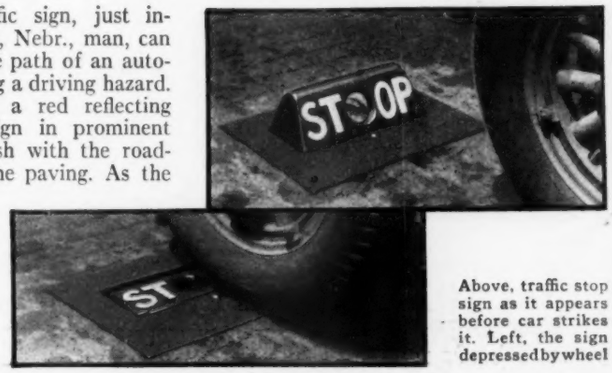


Box, shown above, holds the parachute that is seen at right, until trigger releases it when it drags plane to a stop

A RECENTLY invented airbrake enables an airplane to make an emergency landing in safety by stopping the plane almost as soon as it touches the ground. The brake is a large parachute that opens the moment the plane comes down. While the plane is in flight, the parachute, stowed away in a square box, rests upon the fuselage just ahead of the rudder. When forced to come down in a limited area or upon muddy or snow-covered ground, the pilot pulls a lever in the cockpit to lift the box into position above the rudder. As the tail-skid strikes the ground, a trigger pulls the ripcord of the parachute. Wind rushing through the screened forward side of the box whips out a small pilot 'chute which in turn drags forth the big parachute. In the slip stream of the plane, the latter opens quickly and brings the ship to a sudden stop.

TRAFFIC SIGN SINKS AS CAR STRIKES IT

A DISAPPEARING traffic sign, just invented by a David City, Nebr., man, can be placed directly in the path of an automobile without becoming a driving hazard. The device, containing a red reflecting lens and a warning sign in prominent white letters, is set flush with the roadway over a recess in the paving. As the wheel of a car strikes it, the sign settles into the recess. When the car has passed, springs return the sign to its original position where it is easily seen by motorists.



Above, traffic stop sign as it appears before car strikes it. Left, the sign depressed by wheel

DESIGNS BIG SPRINKLER TO WATER ENTIRE FARM

MAMMOTH sprinklers, towering 500 or more feet into the air, have been designed by a New York inventor as a means of overcoming drought conditions in farming country and also to be used in extinguishing forest fires. The giant sprinklers, working models of which have already been built, would have perforated revolving arms 1,000 feet long. These would be rotated by the force of water striking against blades contained within the spherical hub of the arms. The sprinkler arms would be constructed of duralumin to reduce weight and would be supported by guy cables from the top of the towers. Each tower, the inventor claims, would sprinkle a cultivated or wooded area 2,000 feet in diameter. Water for the towers would be piped from existing dams and reservoirs.

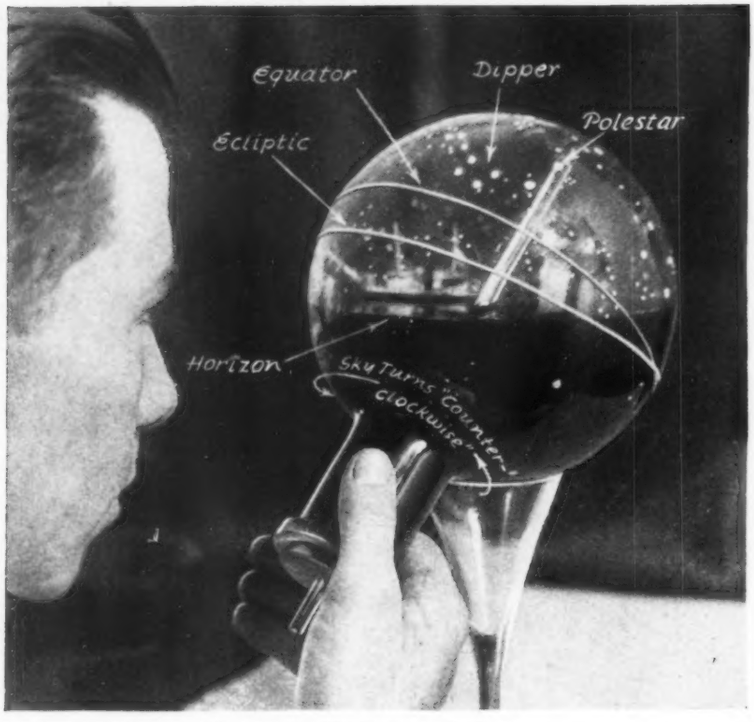
CAN ROSE BUSHES TO KEEP THEM FRESH

ROSE bushes, grown in nurseries, are now canned to preserve their freshness until they reach market. The bushes are pruned to a height of fifteen inches and the branches dipped into melted paraffin. When this thin coating of wax has dried, the roots are wrapped in damp peat moss. The bushes are then packed in cardboard cartons lined with moisture-proof tar at the root end. The cartons are then hermetically sealed. Bushes are planted by tearing away the upper part of the carton and inserting the lower end in the ground. The cardboard is softened by moisture and the roots break through.

IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
IDEAL ROSES FOR YOUR GARDEN
100 ROLLS

Above, dipping rose bushes in paraffin to preserve them. Right, packing bushes in cartons lined with thick tar at the lower end

Homemade Planetarium



A chemist's flask, half filled with inky water and painted with stars according to the diagram below, makes a miniature planetarium. Rubber bands represent the equator and ecliptic, and a wineglass makes a support for rotating the flask

Many Interesting Experiments, Laws, Can Be Performed with

By GAYLORD JOHNSON

STARS move across the heavens, the moon passes through its phases, and the sun rises and sets in pictorial grandeur in a big planetarium. At present only two cities in America, Chicago, and Philadelphia, have these mechanical "universes" in which the movements of celestial bodies can be seen with almost startling fidelity.

Fortunately, however, even if you live far from Chicago or Philadelphia, you need not wholly deprive yourself of the thrills accompanying a demonstration in a planetarium. Many of the astronomical events to be seen in a big planetarium can be duplicated, on a small scale, in your own home with common materials and at slight expense.

The essential articles are a round-bottomed, spherical chemist's flask, several inches in diameter, and a glass rod fitting tightly into a perforated rubber stopper. This rod should reach exactly the bottom of the flask when it is corked tightly. All these essentials can be purchased for less than a dollar.

In order to add to the realism of the ocean horizon, I secured a tiny celluloid boat and floated it upon the surface of the ink-stained water before introducing the glass rod and the rubber cork into my flask. The little steamer helped me to imagine myself at the center of the ocean, out of sight of land, with the sky and sea meeting at the circle of the horizon, where ink and glass meet.

When the stars of the entire celestial sphere have been indicated upon the flask, with dots of white paint, we are ready to duplicate many of the effects visible to the audience under the sixty-foot dome of a big planetarium lecture hall.

The stars whose positions are indicated on your flask are supposed to be viewed by people on the miniature ship, inside the flask. But as we cannot get into the bottle, the best we can do is to look through the bottle at the stars painted upon the opposite side. Accordingly, the star group figures which you paint upon the outside are reversed, because intended to be viewed from the inside.

The first step to be taken in preparing the flask is to place in position two rubber bands of different colors. Let a red band placed around the exact middle of the flask stand for the sky's equator. Then let a gray rubber band, set at an angle of about twenty-three degrees to the other, stand for the ecliptic, or path of the planets, moon, and sun.

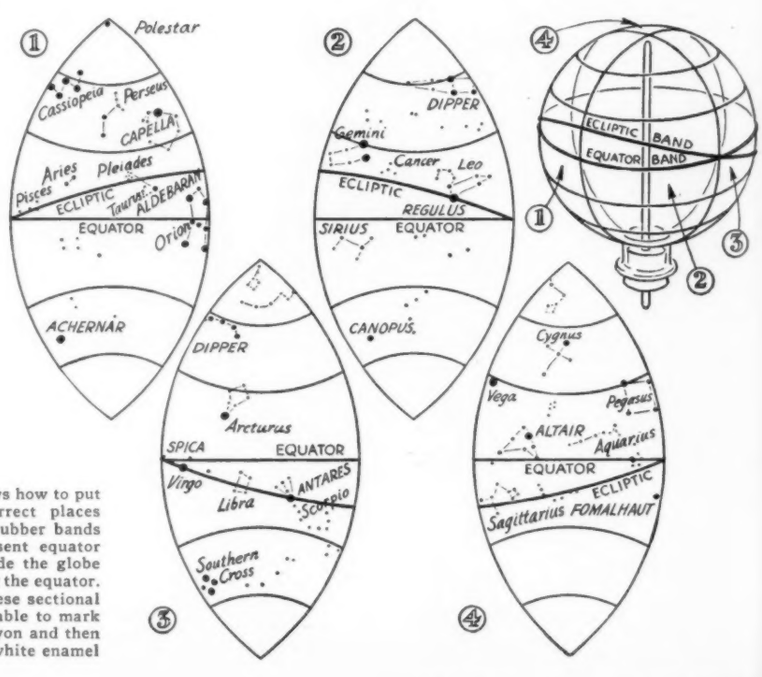
The second step is to divide the distances from equator to poles into equal thirds. This is easily done with a measuring tape or strip of paper. Each third stands for thirty degrees, and the whole quarter-circle for ninety degrees. The divisions are marked upon the glass with a greasy crayon or china-marking pencil, and a circle is drawn through each division. Each circle extends entirely around the flask, and is parallel to the equator band.

With these greasy-crayon lines and the quarter-sphere maps below as guides, it is easy to add the stars with a small brush and dots of white paint or enamel.

When the paint is thoroughly dry, with the flask filled half full of inky water and tightly corked, your parlor planetarium is ready for use. Rest it upon a wine glass, with the glass rod meeting the ink at an angle equal to your latitude. (In New York this is about forty degrees.)

Take hold of the neck of the flask and turn it slowly in a counterclockwise direction.

As you look through the near side of the flask,



This diagram shows how to put stars in their correct places on the flask. Fix rubber bands in place to represent equator and ecliptic. Divide the globe into quarters along the equator. With the aid of these sectional maps you will be able to mark positions with crayon and then dot them in with white enamel

for Amateur Astronomer

Demonstrating Astronomical *this Simple Model Easily Made*

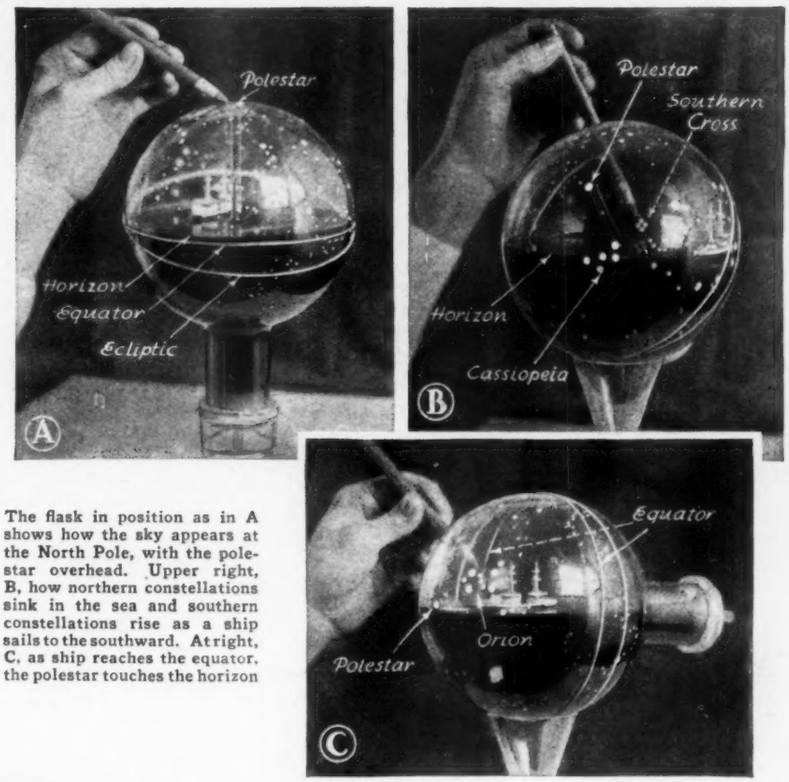
you see some of the stars upon the far side rise over the ocean horizon, cross the sky and set in the sea at the left. Other stars (circumpolar stars) simply go round and round the upper end of the slanting glass rod which represents the axis of the celestial globe. These stars never set. Other stars, seen near the neck of the flask, below the surface of the ink, never rise in northern latitudes.

Now let us go on a trip from pole to pole in our table-top planetarium, just as the audiences do at a planetarium show.

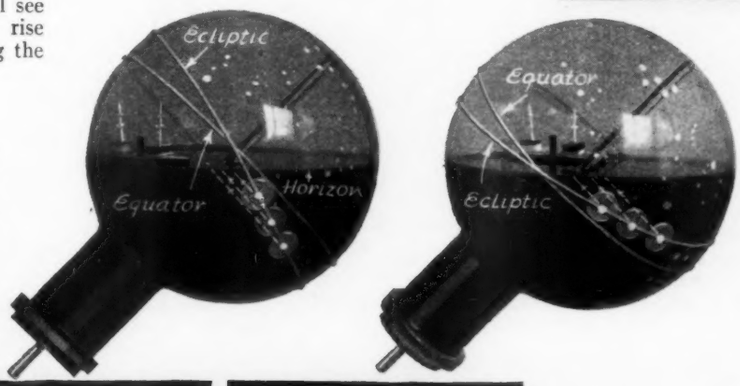
To go northward from our latitude, we simply lower the neck of the flask gradually. You will have to take the apparatus off the wine-glass support and hold it in your hand. As the neck is lowered, the glass rod representing the polar axis of the sky rises. When it is vertical, rotate the flask slowly between your hands and you will see the sky as it would appear if you stood at the North Pole.

Straight overhead is the Polestar and around it the entire heavens revolve. The constellation Orion will be always on the horizon, for the horizon is always parallel to the sky's equator.

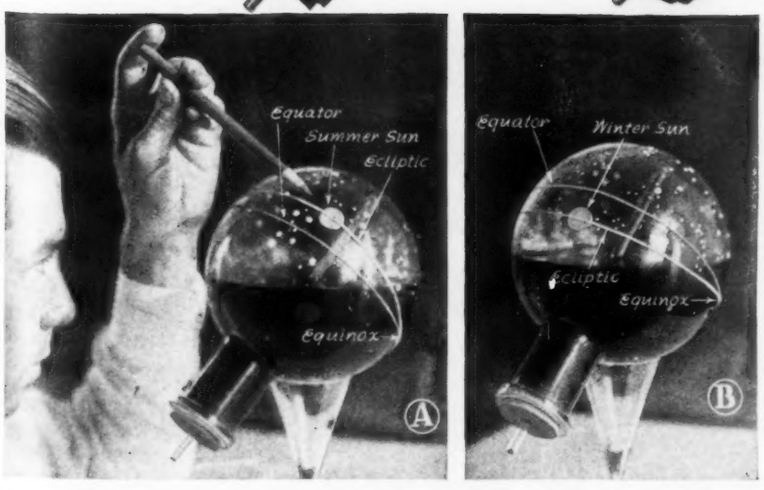
Slip a ten-cent piece under the rubber band representing the ecliptic, at a point below the equator band and rotate the flask as before. You will see why the sun does not rise above the horizon during the six months it is passing over the half of its path which is always below the horizon at the North Pole.



The flask in position as in A shows how the sky appears at the North Pole, with the polestar overhead. Upper right, B, how northern constellations sink in the sea and southern constellations rise as a ship sails to the southward. At right, C, as ship reaches the equator, the polestar touches the horizon



In the left-hand picture, dimes under the ecliptic band show three daily positions of the moon in spring. At the right, the positions in autumn explain how the "Harvest Moon" is caused



Changes of the seasons are explained by this simple experiment. A dime placed under band, A, representing the ecliptic, above the line of the earth's equator, shows the position of the sun in summer; at right, B, below the equator, the sun's winter course

Slip the ten cent piece along under the ecliptic band to the other side of the flask, where the band rises above the equator band. When the flask is rotated, you will experience the midnight sun, when the luminary never goes below the horizon for the six-months'-long summer day.

Now tip the flask back, replace it upon its wine glass support, and continue raising the neck. When the glass rod is level with the surface of the ink, the position of the stars represents what we would see when our ship reached the equator. The polestar is on the northern horizon, and, if it is winter, Orion will pass through the zenith over our heads.

If you continue tipping the flask until the glass rod is again vertical, you will view the stars as they are seen in Little America, and as South Pole discoverers saw them. Orion, the equatorial constellation, is now standing upside down, upon the northern horizon. In fact, all the northern constellations visible south of the equator are standing upon their heads. Another odd point is that the midday sun slants down from the north instead of from the south. In a hotel in Argentina, you would ask for a room with a sunny northern exposure! Your parlor planetarium makes it easy for you to demonstrate this with the dime slipped under the *(Continued on page 120)*

Radio Waves Kill Insect Pests

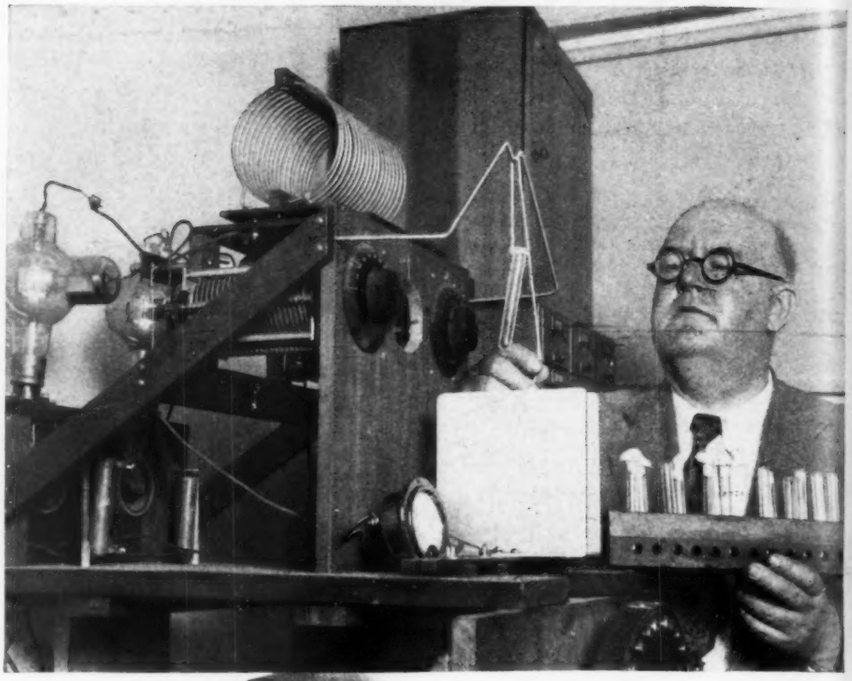
Short-wave Machine Broadcasts Death to Plant Enemies

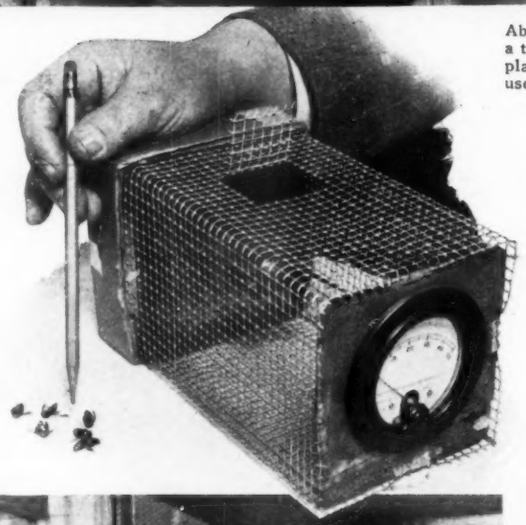
STANDING before a curious apparatus of coils and dials and knobs, a scientist places half a dozen live honey bees in a test tube and seals it with cotton. Attaching a string, he hangs the tube from a hook above the apparatus and lowers it between two square plates of aluminum. Then he slowly twists the contact knob of a giant rheostat. There is no visible movement between the aluminum plates, no visible force. Yet a few seconds later, when the power is shut off and the tube opened, the bees are dead. They have been killed by a death wave.

This new device which is being tested in a laboratory at New Brunswick, N. J., uses the same radio waves as those that carry entertainment through the air except in length. The waves hurtle through the ether at the rate of 3,000,000 or more a second, carrying certain destruction to any insect that obstructs their course. Scientists see in their deadly potency a weapon that will one day free agriculture from the constant struggle against insects.

The apparatus used in the experiment was built under the direction of Dr. Thomas J. Headlee, director of the Department of Entomology of the New Jersey State Agricultural Experiment Station at Rutgers University. The range of effectiveness is still limited but the waves, it is believed, can be projected over any desired distances if the necessary amount of current is used.

The chief difference between the death wave transmitter and that ordinarily used in radio lies in the absence of aerials. Antennae are replaced by two square aluminum plates, separated by a space that varies with the amount of current used. Larger plates and greater power permit the waves to be carried over a longer field between the plates.



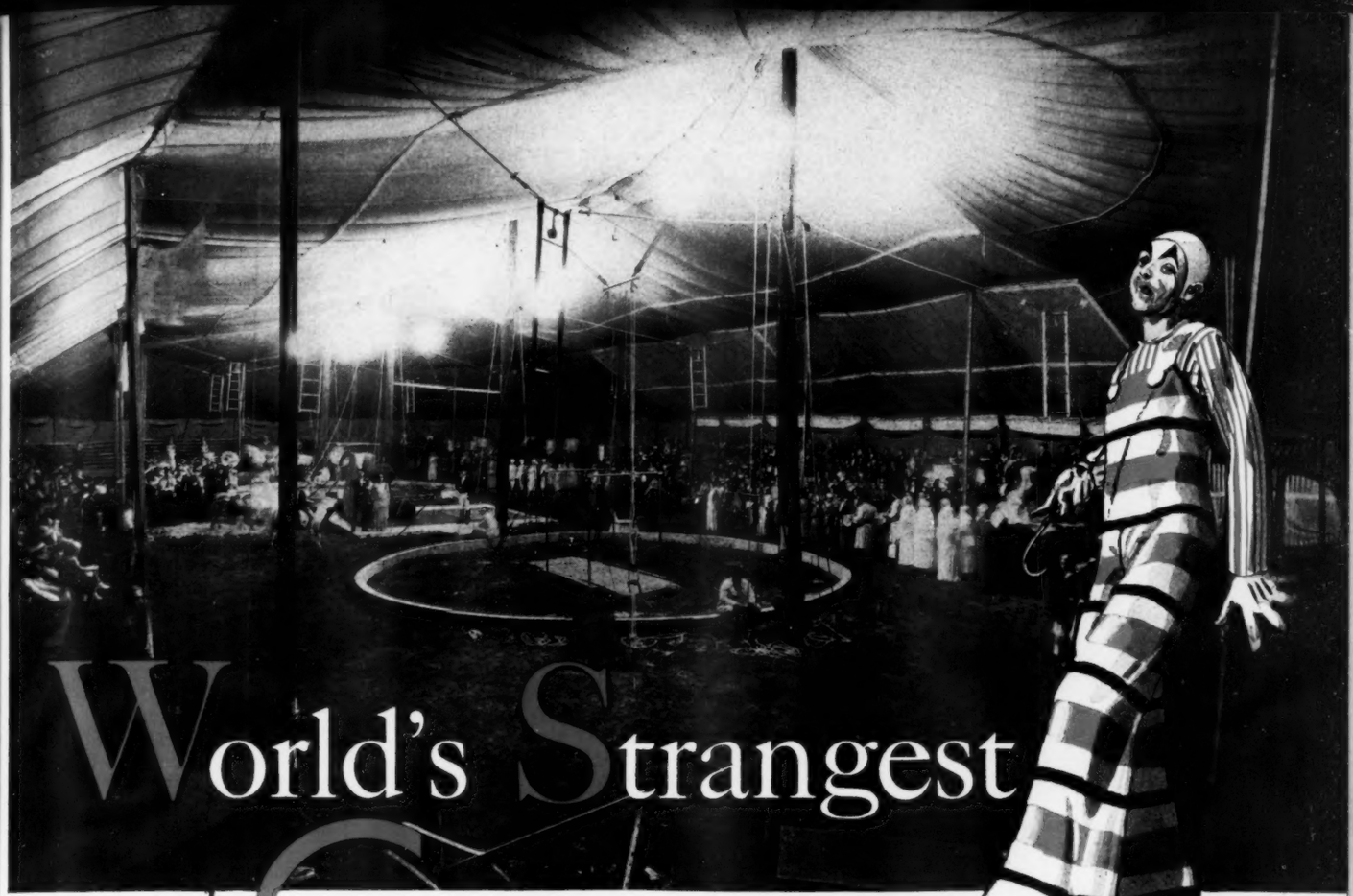


Above, Dr. Thomas J. Headlee lowers a test tube full of insects between the plates of the machine. Left, a device used to gage the absorption of energy

When removed from the field after exposure to the high-frequency waves, insects are found to be changed but little in external appearance. They are neither scorched nor burned, yet their bodies are considerably warmer than in life. This fact has led to the assumption that death is caused by the generation of internal heat in the insects. Scientists, however, are not agreed as to how this heat is produced.

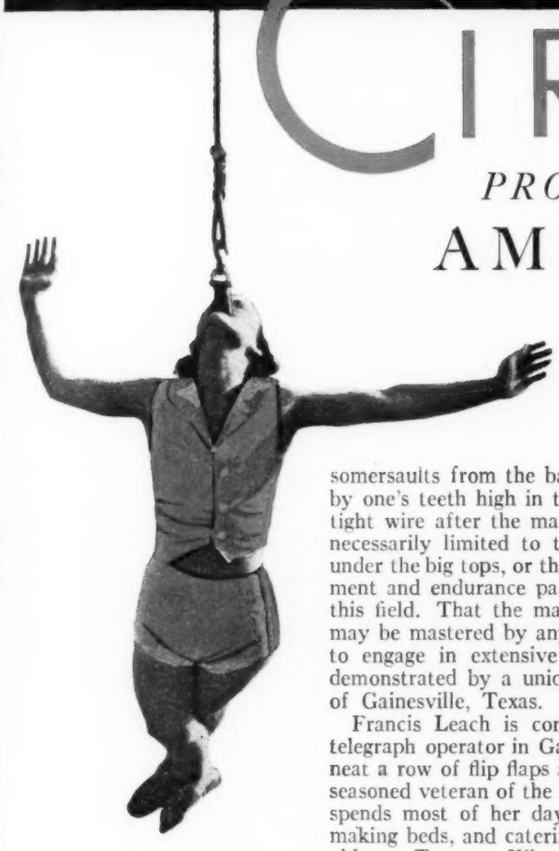
Experiments are being continued, not only to find means of reducing the amount of power required to transmit the death waves over long distances but also to determine the most feasible methods of employing them. It has been suggested that equipment similar to that already developed be used to destroy insects in preparing foods for market. The food, such as grain, vegetables, and flour, would be drawn between the aluminum plates of the transmitter on an endless belt and the insects thus killed. Potted plants have already been freed of insect pests in somewhat the same way. Placed between the metal plates, the plant is bombarded with the waves and the insects destroyed. Unless the frequency is raised too high the waves do not affect plant tissue.

Adjusting the electrodes to rid a living plant of insects. Sketch at left shows how the process could be used to kill insects in foodstuffs



World's Strangest CIRCUS

PRODUCED BY AMATEURS



Dorothy Murphy, one of six girls who mastered the difficult "iron jaw" routine for the Gainesville circus after four months' practice

LEARNING to turn somersaults from the back of a cantering horse, to hang by one's teeth high in the air, or to run and dance on a tight wire after the manner of circus performers, is not necessarily limited to those who have spent their lives under the big tops, or those possessed of physical development and endurance particularly fitting them to excel in this field. That the many and varied arts of the circus may be mastered by any normal person who has the will to engage in extensive practice, has been conclusively demonstrated by a unique organization in the little city of Gainesville, Texas.

Francis Leach is considered an accurate and speedy telegraph operator in Gainesville, but he can also turn as neat a row of flip flaps and back somersaults as the most seasoned veteran of the sawdust ring. Mabel Cunningham spends most of her day cooking meals, sweeping floors, making beds, and catering to the whims of her four-year-old son, Tommy. When the day's chores are done, however, she amuses herself by climbing a rope hand over hand some thirty feet and learning new and daring stunts on the Spanish web. While Bill Ritchie does not find mixing ice-cream sodas and cherry-nut sundaes such an exciting job, he does get a thrill out of diving from a trapeze and catching by his toes as he drops through space.

In private life a department-store window decorator, Walter Lanford is the stilt-walker of the circus

By

A. *Morton Smith*

Evelyn Welborn, a high-school girl, appears to have perfect confidence in Bill Ritchie, with whom she does the "bird's nest" pose away up high on the double trapeze

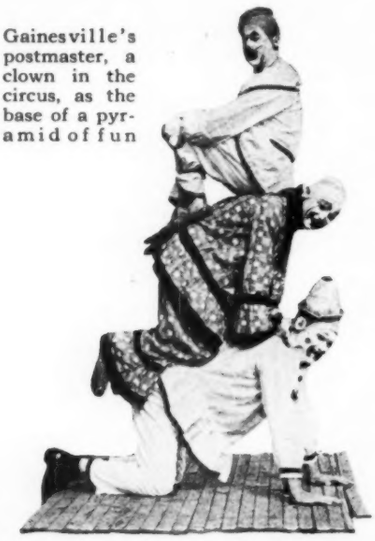
None of these people aspire to become famous stars of the arena, but they are members of the Gainesville Community Circus, the only show of its kind in the world since its personnel is composed entirely of citizens of the town, none of whom has had any professional experience. Yet, this community circus presents a program in three rings which runs the gamut of circus thrills, from loop-the-loop trapeze performers to the slide for life, from shoulder-to-shoulder somersaulting acrobats to head-balancing perch-pole artists.

WHY such an organization is perpetuated and expanded year after year, is difficult to explain, for the town, with a population of 10,000, has not given to the circus world one outstanding artist, no circus caravan has ever maintained its winter quarters there, and the city park does not even boast of a zoo.

Just as a diversion from its routine of dramatic fare, a little theater club in Gainesville produced a burlesque circus in the spring of 1930, and from this show has grown the community circus, now composed of 150 members, who pitch their tents each fall at county and district fairs in Texas and Oklahoma, to provide entertainment for the amusement-seeking crowds. When there are profits, they are invested in additional equipment, for no member receives any remuneration for his services and, in addition, provides his own costumes and rigging.

Anyone who displays enough interest to buy equipment and is willing to give the time required for rehearsals, can join the circus. Usually the performers learn acts that are assigned to them. During the winter months, a committee arranges a tentative program for the next season and selects members to learn new acts. Seldom are there failures in the ranks. The "iron jaw" girls, or the young women who hang by their teeth, furnish a striking example of training for the show.

Prior to the present season, the circus had no "teeth" acts and the program committee welcomed the opportunity to add such a number when a professional aerialist came to town and organized a class of girls for aerial acts. Seven were chosen to learn to hang by their teeth. Six of them were already members of the circus. They ranged from ten to twenty years of age, several of them school students, one a sandwich-shop waitress. When the girls went to a dentist to have plaster impressions of their mouths made, from which hard rubber casts are obtained for the manufacture of their mouthpieces, one was eliminated. The dentist said she did not have all of her permanent teeth.



Gainesville's postmaster, a clown in the circus, as the base of a pyramid of fun

THE other six girls began rehearsals, devoting an hour daily to the work, six days a week. These rehearsals tested their mettle, for there is no more painful and exhausting act in the circus program. During the first month, the girls were able to hang by their teeth for only a few seconds at a time and great quantities of liniment were applied to sore necks. During the second month, they learned to swing pendulum fashion a few feet from the ground, and at the end of the fourth month, they were ready for the show, doing a standard "iron jaw" routine.

Billie Lu Purcell, a junior college student, became so proficient in the teeth act that her instructor devised a special endurance number for her. The young woman hangs by her knees from a high bar and with her mouthpiece supports a spinning girl.

Rehearsals are conducted the year round

Above, a 12-year-old acrobat does his stuff. Right, the practice ring where bareback riders of the circus are taught

at frequent intervals and are intensified when a new season is near at hand. Group rehearsals are held at the homes of several members and each of the performers who do individual acts, has his own practice equipment. Practice rings for rehearsals of bareback riding and for training horses, are maintained at the homes of Virgil P. Keel, a grain dealer, and W. A. Murrell, an electrical engineer. These men are owners of several horses used in the circus performances. The Murrell home is the scene of rehearsals of the entire show for on the spacious grounds is laid out a complete arena with a sawdust ring, an iron frame supporting rigging for aerial acts, and an elevated stage for acrobatic turns.

A gymnasium where performers learn tumbling, horizontal bar work and tight wire walking has been fitted up in a vacant room at the sporting goods store operated by S. G. Staniforth, who trains and participates in the acrobatic numbers. There is hardly an hour in the day when some individual is not working in this practice room.

REHEARSALS of the clowns are conducted principally on paper, that is, the devising of new gags, and their favorite gathering place is the office of the county tax collector in the courthouse, for Joe B. Pettit, postmaster of Gainesville, and Wayne Collins, deputy county tax collector, are the principal clowns, who conceive the acts and walkarounds for the score of funmakers. In a workshop at his home, Collins constructs the equipment.

Every precaution against injury during rehearsals is taken by instructors in charge of acts. The practice rings for the bareback acts are designed to save the performers from damaging falls. They are thirty-two feet in diameter, matching in size those used in the circus tent, but unlike the wooden ring curbs, eight inches high and six inches wide, which are used for performances, the practice rings are constructed of eight-inch shiplap staked out to form a circle, and then generously dirt-banked to provide a soft landing place for the inevitable falls.

In the practice of bareback acts, the performers are further aided by leaping boards, which are elevated about ten inches from the ground, with slanting surfaces. The embryo performer is aided in leaping on the back of the galloping horse by this elevation which is discarded as soon as the rider becomes proficient in timing his leaps to insure an artistic performance.

A mechanic, or safety belt, has been found indispensable in the practice of several types of acts. A leather belt, which fastens around the performer's waist, has large harness rings sewed on each side, to which are attached ropes that run through pulleys hung from the ceiling of the gymnasium or from the frame to which aerial rigging is attached. The ends of the ropes are held by the instructor or assistant, and when a performer makes a slip and a fall is inevitable, he is prevented from striking the ground by the assistant who takes up the slack in the rope and leaves the performer suspended in the air. The mechanic is used for practice tumbling which involves somersaults and flip flaps, tight-wire walking and certain aerial acts.

The safety belt is discarded

Billie Lu Purcell became so proficient in "teeth work" that a special act was created for her, supporting another performer

In circle, Mabel Cunningham, a housewife who enjoys working on the Spanish web. Left, 11-year-old Jimmie Scruggs in her bareback act with George Tyler, a filling station operator

No circus would be complete without a freak automobile. The Gainesville show has one that seems to drive itself, the driver being concealed behind the false upholstery of the back seat

only after the instructor and performer are confident that the act has been perfected. As a result of these precautions, there has never been a serious accident during the sixty performances given by the circus in the past five years.

Performers have been injured but, curiously enough, they were hurt only in rehearsals and no one has been prevented from continuing his circus activities. Ray Whittaker, telegraph messenger boy, sustained a broken arm making an improper landing after turning a somersault from a teeter-board. Mrs. Floyd Garret, who is instructor for the aerial ladder act, broke her left arm at the elbow while demonstrating for a class of girls. Dorothy Murphy had practiced daily for three months in a bare-back riding act, only to catch her toe in a hand grip on her horse's rigging on the eve of the first performance of the season, and suffered a broken leg in the fall. County Judge B. F. Mitchell, 67, the oldest member of the circus, missed the net into which he was supposed to jump during the clowns' firehouse act, and suffered a wrenched back. For several weeks he conducted court from his bedside.

From one year to another, the quality of the program has improved. The first two years, several of the acts were not strictly of a circus nature. In the beginning, only men and boys took part in strenuous acrobatic and aerial acts and to add a feminine touch to the performance, there were solo dances, ballet and human statue numbers. Typically amateur features were barrel walking and rope skipping, and from the popular sport of the southwest, the rodeo, were borrowed rope spinning and trick riding.

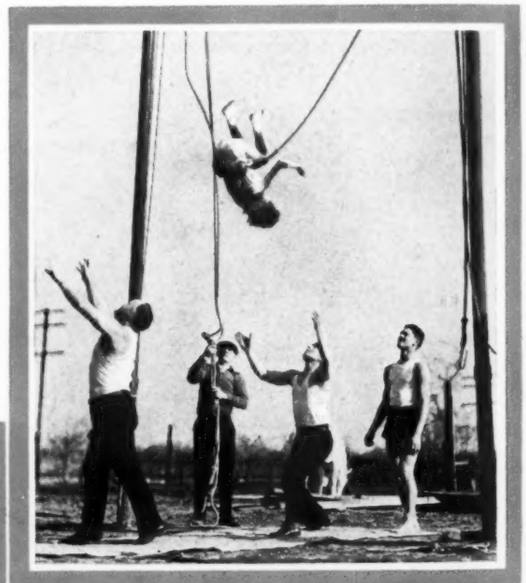
Mrs. Geraldine Murrell, young society matron, is one of the dainty aerialists of the show

These fill-in numbers have been gradually eliminated and today the program is exclusively circus from the opening tournament to the high-school and dancing horses that close the show. Oddly enough, there are now more feminine performers in every type of act than men. Girls have learned trapeze, acrobatic, riding, tight wire, and balancing feats with even more enthusiasm and skill than the men and boys.

There has been a minimum of professional training of performers. Two years ago, a professional contortionist spent two months in Gainesville and trained several youngsters in contortion work and a group of girls to perform on aerial ladders. Last winter, two professional performers, James Parker, an English gymnast, and Ethel Livingston, one-time aerialist of Sells-Floto Circus, spent several months in town. They organized classes, Parker teaching acrobatic routines, while Miss Livingston gave instructions in trapeze, roman rings, and "iron jaw" acts. Otherwise the performers have been taught by volunteers from the amateur ranks of the circus, who have studied the work of professional artists seen by frequent visits to the circuses which tour that section of the country.

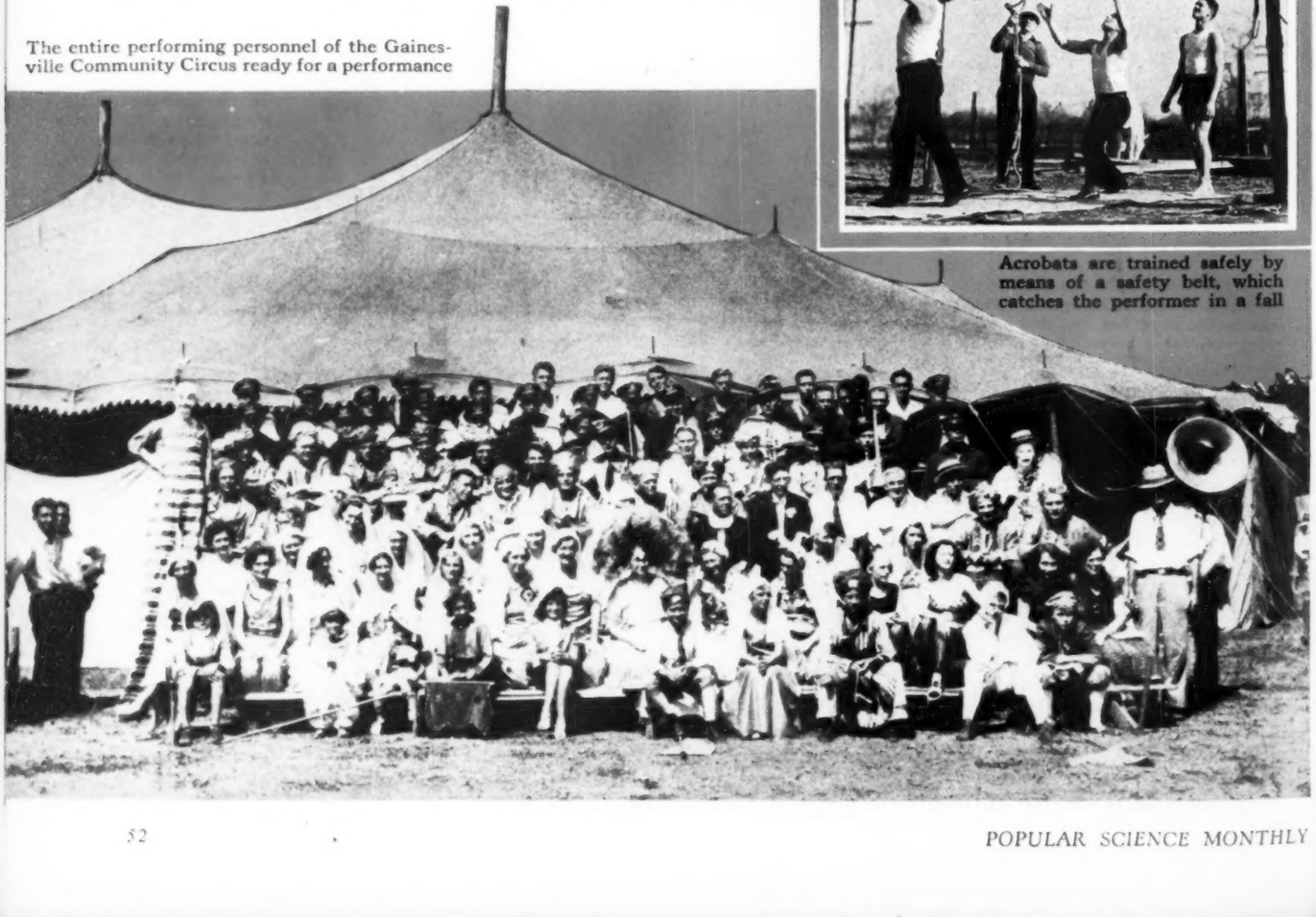
The program is presented in two rings, on an elevated stage and on a hippodrome track which surrounds the arena. This season, the performance consists of eighteen numbers with from two to eight acts presented simultaneously, opening with a pageant in which the performing personnel is attired in oriental costumes. Mrs. Pauline McArdle, a church choir soloist, is prima donna, and Camilla Williams, a dancing teacher, is premier danseuse. A fireworks display closes the spectacle.

Acts change at the direction of J. N. McArdle, a cotton merchant, who is ringmaster or equestrian director, his shrill whistle a mace of authority. The aerial acts include girls on swinging ladders, the "teeth" acts, *(Continued on page 114)*

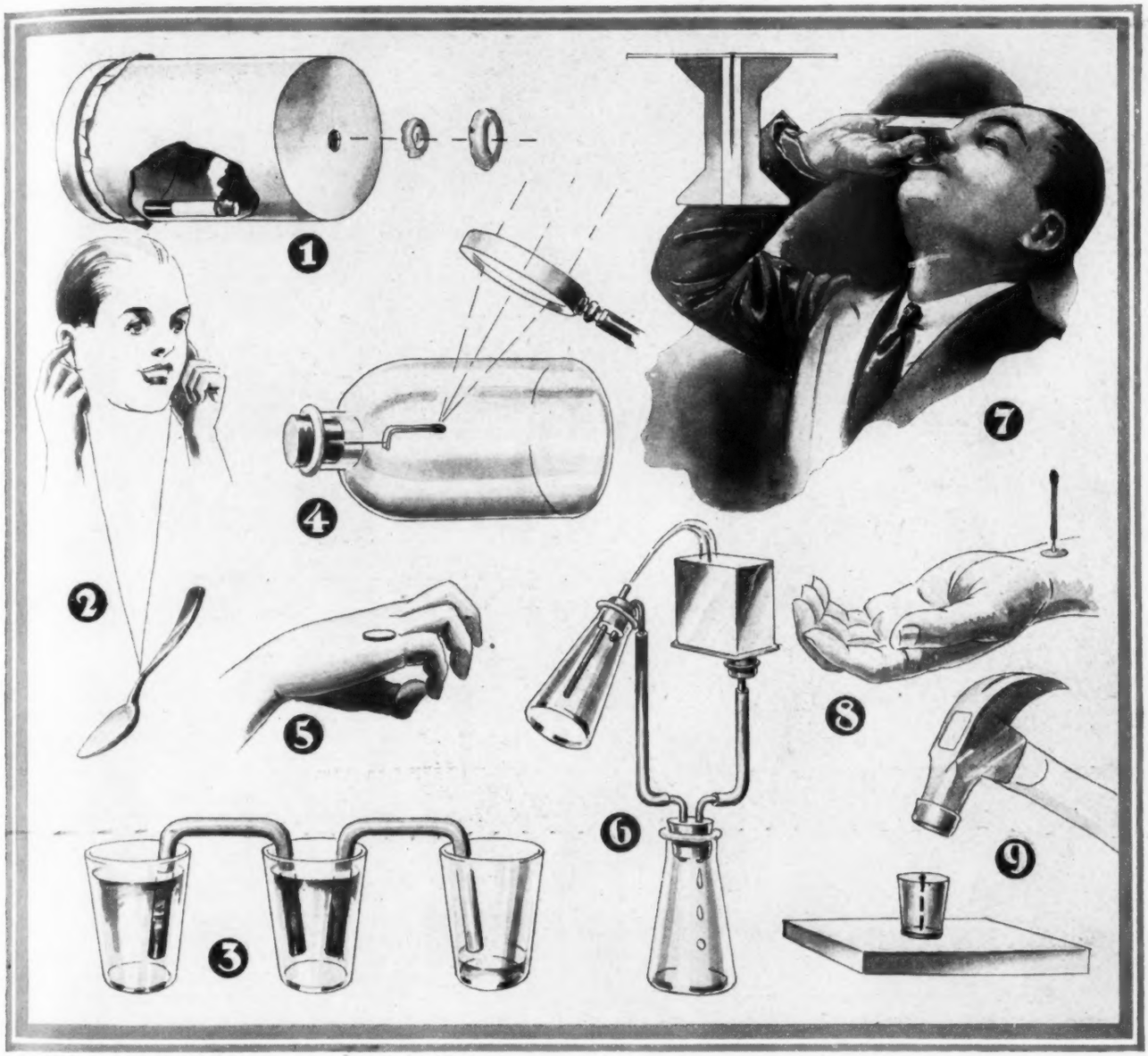


Acrobats are trained safely by means of a safety belt, which catches the performer in a fall

The entire performing personnel of the Gainesville Community Circus ready for a performance



Scientific Tricks for Home Magician



1 SMOKE RINGS. Dry a can and punch a round, half-inch hole in the bottom. Tie a piece of wrapping paper over the top. Drop a lighted cigarette in through the hole. Let the can fill with smoke. Then tap the paper gently. Fine smoke rings will come out, due to the diaphragm like action.

2 CHIMES FROM A SPOON. Hang a large spoon by strings of equal length, tied at the middle. Make loops at the ends and insert your forefingers. Put your fingers in your ears and swing the spoon against a chair. You will hear beautiful chimes.

3 TRICK SIPHON. Fill two lengths of rubber tubing with water, cover the ends, and drop into water-filled tumblers as shown. Lifting any tumbler makes water flow into the others until the water levels are equalized. The water makes a surprising sight as it runs up and down hill.

4 MAGIC CANNON. Pin two or more cardboard matches to the small end of a cork. Insert the cork in a dry bottle, and ignite the matches with a reading glass held in the sun's rays. The cork will come out with a bang as a result of the expansion of the air.

5 SOMERSAULTING COINS. Place a cent or a dime over the knuckle at the base of your little finger. Put the end of the little finger *under* the thumb and flick the thumb away. The coin will somersault and land on your hand the other side up. Your friends will fail because they will place the fingers wrongly.

6 "PERPETUAL MOTION." When the simple apparatus shown is set up, water will rise *above* its source—the open tin reservoir at top right. The water flows into the lower flask, forcing air into the upper flask, and water spurts upward from the glass nozzle.

7 CARD YOU CAN'T BLOW OFF. Put a pin through the center of a card. Drop the pin into the center of a spool and blow through the spool from the bottom, as hard as you can. You can't lift the card.

8 SEEING YOUR PULSE. Stick a match upright on the point of a carpet or thumb tack. Stand the head of the tack on your wrist, at the place where you can feel your pulse. The head of the match will bow solemnly each time your pulse beats.

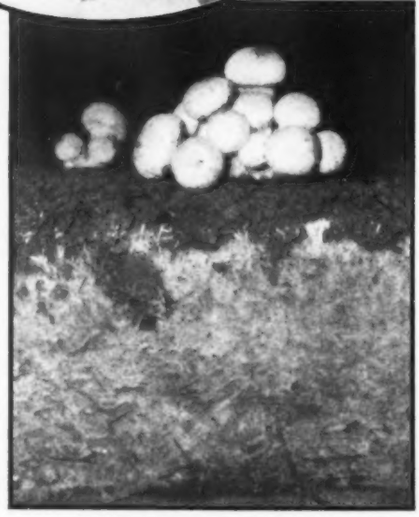
9 NEEDLE DRIVEN THROUGH COIN. Thrust a needle through a cork until the point appears. Then break off the part of the needle projecting. Place a penny on a piece of wood, and the cork upon the coin. Hit the cork with a hammer and the needle will pierce the penny! This is always a surprising trick to perform at a party.

One kind of mushroom spawn comes in milk bottles. This variety produces pure white mushrooms. To secure the spawn for planting, it is necessary to break the bottle, as shown below

Three stages in the life of a mushroom. At left, the button stage, in the center, the ring-breaking stage, and at the right, the final stage when the mushroom is mature

You Can Grow Mushrooms IN YOUR CELLAR

After the compost has been placed in the bed and brought to the desired temperature, a bit of the spawn that has been broken off, is placed in the bed and covered with three inches of the loam



Right, cross section of mushroom bed showing the compost at bottom, the white streaks of spawn, the covering of loam, and mushrooms at top

IF YOU would like to grow your own fresh mushrooms throughout the winter, now is the time to begin. Beds prepared now will give you, without great labor or expense, a crop of mushrooms for three or four weeks in January or February and a second crop in the early spring.

Methods employed by commercial growers are sometimes elaborate, but successful mushroom culture requires no facilities not possessed by the average person. If there is any secret, it lies in the exercise of reasonable care.

The first requisite for the mushroom grower is a dark spot where an even temperature can be maintained. This can be a cellar, cave, greenhouse, roothouse, or other existing structure. If no such location is available, a shed can be built of cheap boards and earth banked against the outside of the walls to insulate them against heat and cold.

The beds are made of lumber one inch thick. They should be eight inches deep and should not be wider than four feet, as this is the greatest width over which the maturing mushrooms can be picked conveniently. If the tier method, favored by commercial growers, is followed, eighteen inches should be left between the top of one bed and the floor of the bed above.

When finished, the beds are filled with compost. This consists of clean horse manure mixed with an equal weight of fertile loam. The manure should be obtained from stables known to use no disinfectants or chemical cleaners. The chemicals interfere with the quick germination of the mushroom spawn.

In preparing the compost, it should be turned over daily and kept dry. As it begins to ferment, its heat will rise rapidly and then fall. When it has dipped to eighty degrees Fahrenheit, it is ready to be placed in the beds. In placing it, care should be taken to press it down firmly a few inches at a time until a depth of eight inches is reached. Less compost will not keep the bed warm enough; more will cause it to heat too rapidly.

The spawn is now introduced. This is obtained from seedmen and can be had in two varieties. One comes in cakes about nine inches long and about six inches wide, looking like slabs of worn leather. Mushrooms raised from this spawn are creamy white. Another and more popular variety comes in quart milk bottles, which are broken to extract the spawn. This variety gives pure white mush-

The mushroom grower, above, is pointing to the white streaks that appear in a mushroom bed. The streaks are the spawn or mycelium. When this covers the entire bed, you can be sure mushrooms will grow

To secure the spawn that you place in your mushroom beds, a bit of compost is inoculated with spores taken from previous cultures. The inoculation process as now in use, is illustrated in the picture shown below

rooms. Whichever spawn is used, it is broken into pieces about the size of a hen's egg. The pieces are inserted in the bed by burrowing out holes about three inches deep and a foot apart in every direction. The spawn is carefully covered after insertion.

There is nothing more to do until the white streaks of spawn, or mycelium, have spread through the entire bed. At this time, a one-inch covering of screened loam is spread over the bed. It is then necessary only to keep the room reasonably humid and at a constant temperature of about sixty degrees. An oil stove will furnish adequate heat. Some sort of ventilation is desirable to speed up growth. Commercial growers sometimes blow water-washed air through the mushroom houses.

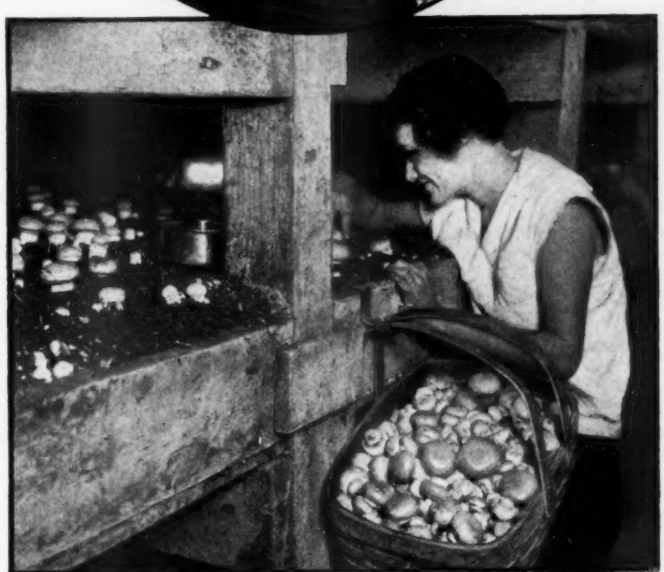
No water is required by the beds, if the humidity of the air has been maintained, until the first mushrooms appear. Usually this germinating period takes about four months. When the mushrooms do appear, a light sprinkling once a week with water heated to 100 degrees should furnish sufficient moisture.

The mushrooms do not all appear at once. They come in waves, known to commercial growers as flushes. These will recur at intervals for three or four weeks. The soil is not exhausted, however, with the disappearance of the first crop. If a dressing of fresh loam about half an inch deep is spread over the bed and beaten down, a second crop, often better than the first, will arrive in two to three months.

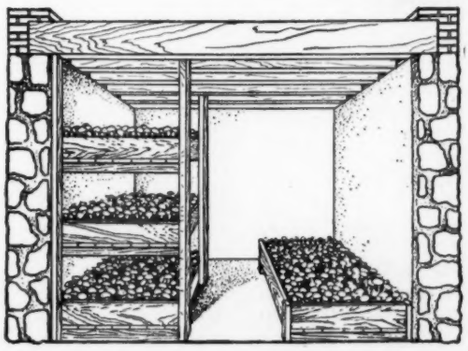
Light may be taken into the shed or cellar to harvest the mushrooms when dimples appearing in their tops indicate that they are ripe. As the beds are only four feet wide, every corner can be reached easily. One should be careful to remove the stumps or any decayed material. Mushrooms of desirable size are often found in the midst of a cluster. These can be plucked by holding down those not wanted and slowly rotating the desired mushroom.

After the second crop has been harvested, the beds are exhausted and should be cleaned out and refilled with new compost and impregnated with new spawn. The compost removed is still valuable for less specialized purposes. It is much used as fertilizer on lawns and golf courses.

Build the beds from any old material you have on hand. They should measure six feet from front to rear, two feet from top to top. Leave a space of about eighteen inches between bed and wall to facilitate picking, and a walk-way of about thirty inches between beds should you erect two tiers. You can pick from as many as six beds, one above the other, if you wish to build half a dozen and thus make full use of whatever room you have available.



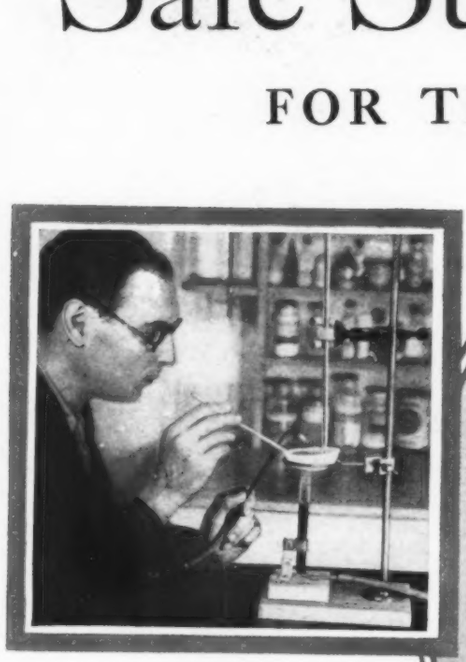
Above, a picker in a large California mushroom house is using a gasoline light to illuminate the work. At this stage light will not injure the plants. At right, picture illustrates correct way of picking mushrooms. It is easy if the plant is rotated



At left, diagram showing how a cellar mushroom bed should be laid out. It must be insulated to maintain an even temperature and while the plants are growing all light is excluded

Safe Stunts with Fire

FOR THE HOME CHEMIST



The flash point and burning point of an oil can be determined by the simple test shown above. A thermometer gages the amount of heat required

The heaviness of gasoline vapor is shown by the experiment pictured at the right. A half teaspoonful of gasoline is placed in a can and the vapor thus formed is poured down a trough made of a miter box. It is ignited by the flame of the candle placed at the bottom of the box

A mixture of carbon disulphide and carbon tetrachloride burns with an almost heatless flame. A piece of paper held in the flame merely chars

By Raymond B. Wailes

OF ALL home chemistry experiments, tests with combustibles offer the most in spectacular fun and harmless excitement. For even after some 60,000 years of use, fire still holds a mysterious fascination.

Although we are accustomed to kindling a fire with a match or some other small flame, a spark or a flame are by no means necessary to start some substances burning. Many materials ignite spontaneously when subjected to nothing more than a slight rise in temperature. Carbon disulphide, a liquid often used as an ant exterminator, is one of these substances and for this reason presents a serious fire hazard if not handled carefully.

To demonstrate the mysterious action of spontaneous combustion, heat the bulb of a chemical thermometer (Centigrade) until the mercury climbs to the 250 mark. Then hold the bulb near the surface of a small amount of carbon disulphide contained in a shallow dish. Almost instantly, the liquid will burst into flame. No actual source of fire will have been used, yet the liquid will be ignited as readily as if it had been touched off with a match. Finally, extinguish the flame with a tin cover placed over the dish and repeat the experiment using an iron rod which is hot but not visibly hot. Again the liquid will burst into flame.

A similar and more common action takes place when oily rags, especially cloths used by painters, are stored in a warm place. Before long, slow oxidation of the oil takes place and the heat generated by the reaction raises the temperature to the kindling point of the cloth.

By using a simple collection of materials including two olive bottles or large test tubes, the home experimenter can illustrate spontaneous combustion graphically. Mold a small quantity of cotton waste or scrap thread into two loose balls, making each about the size of an egg, and stuff one into each of the olive bottles. Pour some ordinary machine oil into one container and a mixture of linseed oil and regular paint drier into the other. Then embed the bottles in a large container insulated with wads of cloth to prevent the conduction or radiation of heat. After placing a thermometer in each bottle, watch the two columns of mercury.

In a short time, the bottle containing the linseed-oil-soaked cotton will show a steady increase in temperature. This will be caused by the slow oxidation of the oil, the chemical reaction being aided by the addition of the drier. At this point, the mixture will be going through the early stages of spontaneous combustion and if allowed to continue until the temperature reached the kindling point, the oil-soaked cloths would burst into flame.

On the other hand, the thermometer in the second bottle will show little change in temperature. This can be explained by the fact that machine oil, a form of mineral oil, does not oxidize as readily as a vegetable oil and therefore does not produce large quantities of heat in the process.

As this experiment will show, spontaneous combustion is a collective reaction. At the start, the vegetable oil begins the cycle by combining with the oxygen in the air. This produces heat which in turn promotes a more rapid combination or oxidation and produces more heat. Naturally, it is only a matter of time before the temperature builds up to the point where the oil-soaked cloth takes fire.

Just as carbon disulphide is a dangerous

liquid that bursts into flame with the slightest increase of temperature, another liquid carbon compound, carbon tetrachloride, is equally active as a fire extinguisher. When thrown or squirted on a fire, it cools the flame and blankets the base of the fire with a heavy cloud of gas that soon cuts off the necessary supply of air and oxygen.

Strange as it may seem, however, even carbon tetrachloride can be made to burn under the right conditions. When placed in contact with powdered zinc and sand, for instance, and ignited with a magnesium fuse, the combination will burn to give off large quantities of heat and larger quantities of smoke. It is this mixture which forms the basis of the smoke pots used by armies in war time and because of the large quantities of smoke given off, the experiment demonstrating it should be performed out-of-doors.

First select a small tin can and fill it three quarters full with a mixture of equal amounts of extremely fine sand, road dust, or fuller's earth, and finely powdered zinc. Carbon tetrachloride then should be poured into the can until the mixture is thoroughly soaked. Any excess not absorbed by the powder can be poured off. Finally, make a small conical depression in the top of the damp mixture, fill it with powdered magnesium, and top it off with a strip of magnesium to act as a fuse.

Once the magnesium is ignited, it will prime or ignite the mixture and start the chemical action which produces the billows of dark gray smoke. What actually happens is this: The zinc in burning combines with the carbon tetrachloride to form zinc chloride and particles of black carbon. The zinc chloride then reacts with the moisture in the air to form white zinc oxide which, together with the particles of black carbon, make up the dark gray smoke. Incidentally, miniature smoke pots of this type are a valuable property for amateur theatricals.

By combining the two carbon liquids used in the experiments so far, the home chemist can produce an almost heatless flame. Mix three parts by volume of carbon disulphide with eight parts of carbon tetrachloride and light the resulting solution. The temperature of the flame will be so low that a piece of newspaper, generally considered as being particularly inflammable, held in it will not burn. It may char, depending on conditions, but it will not burst into flame.

In experiments to determine the combustibility of inflammable materials, fire department officials have found that heavy vapors often flow along surfaces for many feet to be ignited by some distant flame. A simple home-laboratory experiment that shows the heaviness and flowing qualities of gasoline vapor can be performed by pouring a half teaspoonful of liquid gasoline into a beaker. In a short time, the beaker will be filled with a heavy vapor of gasoline. If it is then carefully tipped, the heavy vapors can be poured into a second beaker. Finally, being careful to keep away from the first beaker containing the liquid gasoline, invert the second beaker containing the vapor over a lighted candle or match. The gasoline vapor will literally pour out of the beaker and take fire with a lazy, floating flame.

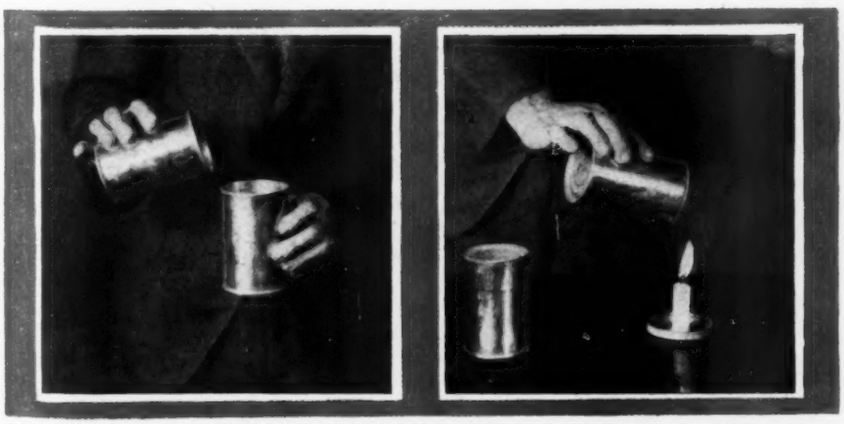
From your experiments with spontaneous combustion, it must not be assumed that mineral oils do not burn. Nothing could be further from the truth. It is the mineral type of oil that is used as a fuel for heating. In fact, two specifications on which mineral oils are graded are their flash point, the temperature at which their vapors when mixed with air will explode, and their fire point, the temperature at which they will take fire and burn.

As a practical experiment in combustibles, the home chemist should obtain several lubricating oils and test them for flash and fire points. The equipment required is particularly simple and the results obtained are comparatively accurate.

A miniature smoke pot, similar in principle to those used in warfare, can be made as shown in the drawing above. Carbon tetrachloride, sand, zinc dust, and magnesium are the materials used

TEST OF SPONTANEOUS COMBUSTION

A bottle containing linseed oil and cotton cloth shows a gradual rise of temperature due to the reaction which produces spontaneous combustion. A similar bottle, in which machine oil is used, does not show corresponding heat change



A few drops of gasoline placed in a can soon fill it with vapor, which can be poured into another can like water. It may then be poured into the flame of a candle, where it will burn harmlessly

First place a shallow evaporating dish or the friction top of a tin baking soda can on the support of your laboratory stand as shown in the photographs, arranging it so that it is held over the tip of your regular gas burner. Then rig a thermometer vertically and allow its bulb to dip into a small sample of the oil placed in the dish. Also arrange a small pilot light by fitting the spout of a small oil can to a piece of rubber tubing leading to your gas supply. When you have lighted both the gas burner and the pilot light you are ready to proceed. The burner should heat the oil slowly and the pilot flame should be no larger than the head of a large match.

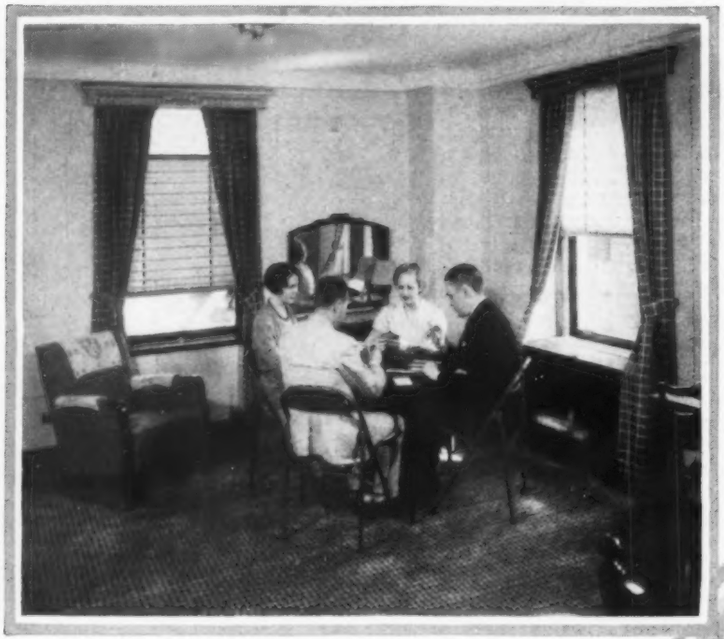
Stir the oil slowly and whisk the tiny pilot flame across the surface of the oil at ten-second intervals. As the temperature increases, watch the oil carefully. Sooner or later, whisking the pilot across the oil will cause the oil vapor to ignite with a momentary flash. The reading of the thermometer then will be the flash point of the oil.

Continue the heating and resume the whisking process with the pilot light. The moment that the oil catches fire and continues to burn, read the thermometer again. This second reading will be the fire point.

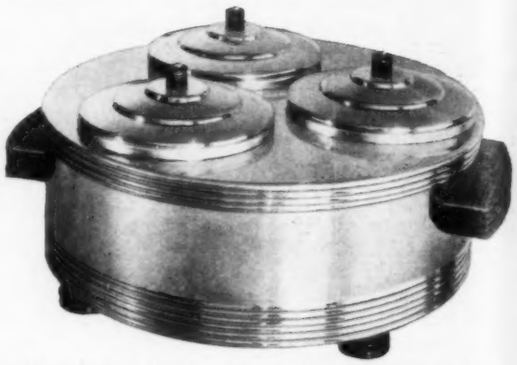
The differentiation between the two points is easily recognized. At the flash point only the vapor given off by the oil takes fire and it will stop burning the instant the pilot flame is removed from the vicinity of the oil. At the fire point, on the other hand, the oil will continue to burn of its own accord until it is extinguished by smothering it with a sheet of tin.

To prove that oils differ in characteristics, the home experimenter should test various types and grades of oils for their flash and fire points. If a test is repeated, a fresh sample *(Continued on page 120)*

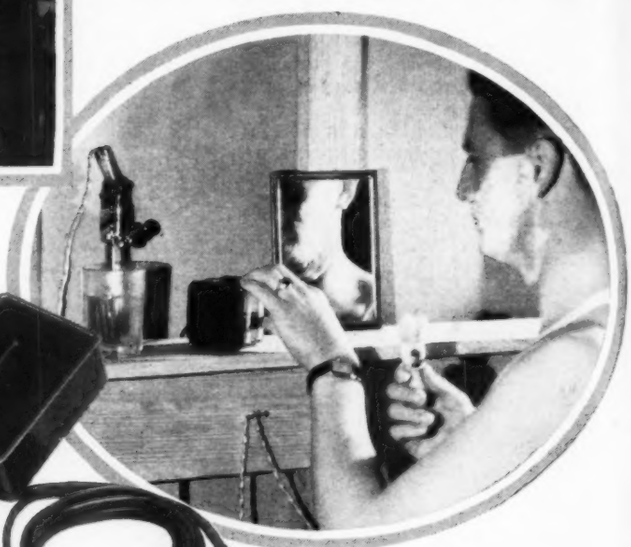
Novel Appliances *for the*

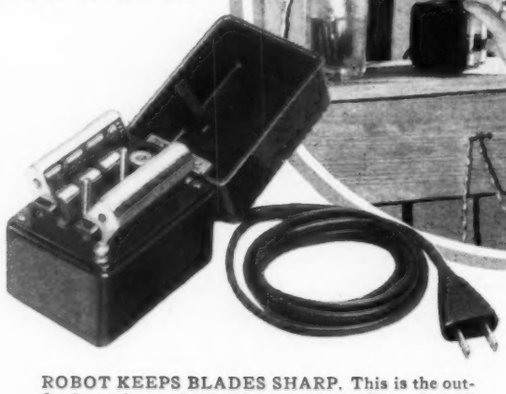


WATERPROOF WINDOW SHADE. Made of pleated fabric, that is waterproof, a new type of window shade can be lowered, or folded accordion fashion, to cover any desired portion of the window. The blind is raised in the ordinary way but is folded by use of a cord



SMALL STEAM TABLE FOR THE HOME. Food is kept at any desired temperature in this tiny steam table. Its three containers of heat-resistant glass are kept warm with electrically heated water. The heating element is in the base





ROBOT KEEPS BLADES SHARP. This is the outfit shown in use in the photo in circle. It is plugged into any convenient socket and is ready for use

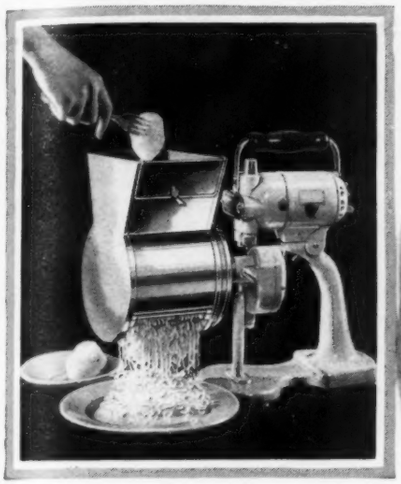
RAZOR SHARPENER. Electrically powered, this razor sharpener automatically hones and strops razor blades. The power is turned off when blade is sharp

NO TIME LAG IN NEW THERMOSTAT

Operating on a new principle, this thermostat actually anticipates temperature changes, according to the manufacturer, and so governs the heating plant without a time lag. Placed near the baseboard, as above, it governs the temperature in the lower portion of the room. View at upper right shows thermostat open revealing electric element that works the controls in response to difference in temperature between it and the room, thus bringing quick action

PERCOLATOR RINGS BELL. When coffee is properly prepared, the electric percolator, shown in these two views, rings a bell. By moving a lever, it can be set to deliver from two to eight cups. The inside of the percolator is graduated as a guide in filling it. The interior parts of the pot are shown in photo below

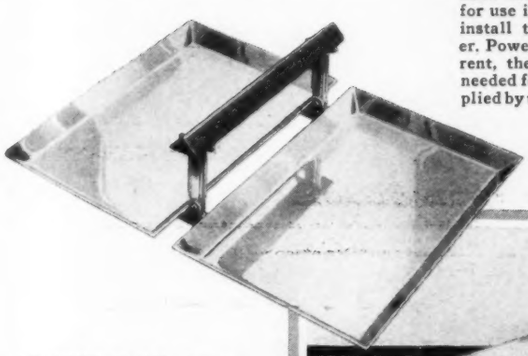
Household

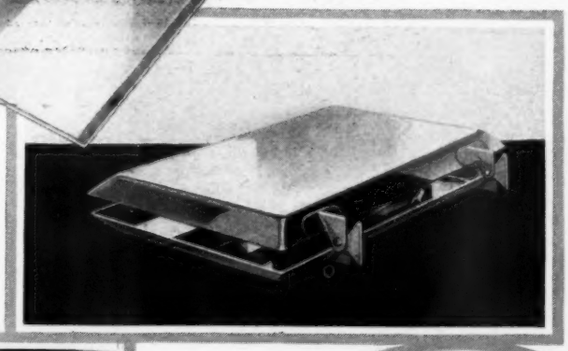


ELECTRIC MIXER. Fruits and vegetables to be used in jellies or soups are dropped into the hopper of this colander and a switch turned. House current operates the mixer

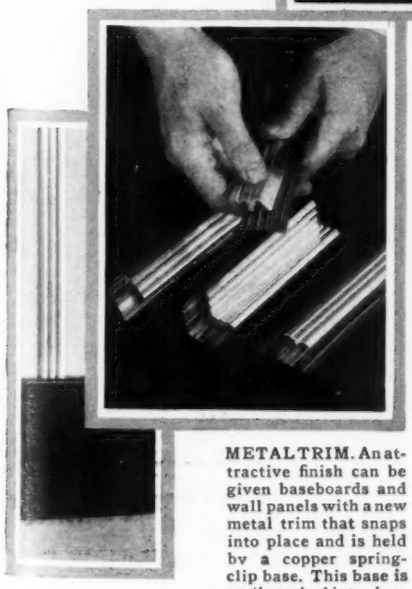
FRESH COFFEE. You can have fresh-ground coffee for use in your home if you install this electric grinder. Powered by electric current, the amount of coffee needed for each meal is supplied by turning control ring

AIR PURIFIER. This air circulator is installed in the attic of a house and electrically operated. It has a three-blade fan that causes a steady circulation of air so odors and smoke are drawn from the lower rooms





FOLDING TRAY. Ample room for a spread is provided by this tray when open as shown above. When closed, as at the right, it is conveniently put away in any small restricted space



METAL TRIM. An attractive finish can be given baseboards and wall panels with a new metal trim that snaps into place and is held by a copper spring-clip base. This base is easily tacked into place

MAKING ICE CUBES Housewives who do not have automatic refrigerators can still have ice cubes with the aid of the device shown above. Filled with hot water and set on top of a block of ice, its cutting edges quickly sink into the ice. Then when it is lifted off, the cubes thus formed can be easily removed

ANYONE CAN BUILD THIS *Short-Wave*

NOVEL DESIGN MAKES THIS SET

Unlike most short-wave superheterodynes, this receiver requires only one set of coils. Note how the controls are mounted

By

J. A. Worcester, Jr.

NEW features make this powerful superheterodyne the ideal receiver for the short-wave experimenter. It is easy to assemble and the cost of its parts—about twenty dollars—hits a new low for advanced receivers of this general type.

Where selectivity and dependable all-around reception are concerned, no short-wave circuit can compare with the well-designed superheterodyne. Unfortunately, up until now, complicated design and high noise level have placed the average experimental short-wave superheterodyne circuit at a distinct disadvantage. In this receiver, however, ingenious design has overcome these difficulties and placed its cost on a par with the simpler, but less effective, regenerative hook-up.

Unlike most short-wave superheterodyne circuits, for example, this novel receiver requires but one set of plug-in coils instead of the usual two. This not only cuts the operations of band changing in half but allows a substantial saving in parts as well.

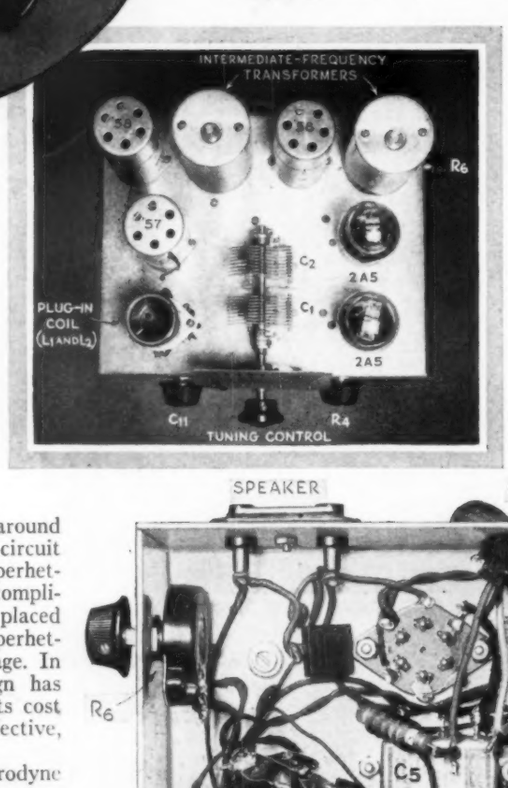
Still another economy is effected by using a special, single intermediate-frequency stage in place of the two stages generally used. Of course, to bring the selectivity and sensitivity of this single stage up to the standard of two, regeneration must be used in the second detector. Although this necessitates a regeneration control (R_6), once it is adjusted, it can be disregarded.

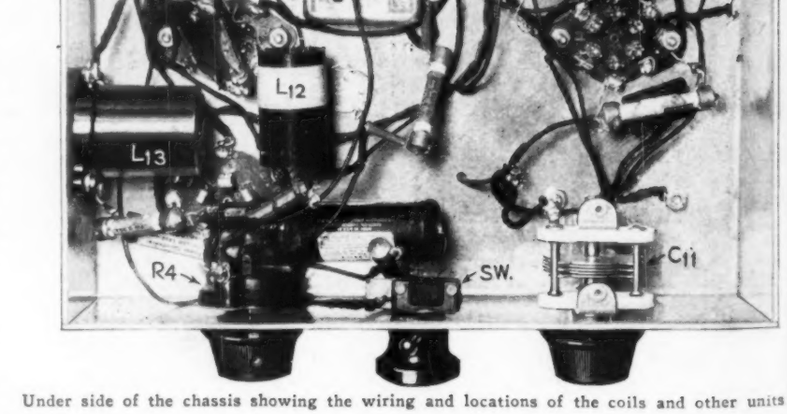
A valuable addition to any superheterodyne is an auxiliary circuit known as a beat-frequency oscillator. Without it, code-station transmissions will be heard only as a series of clicks. Generally, however, the inclusion of such a unit in a receiver requires additional expensive equipment in the form of a tube and transformer. This increases both the size and the cost of the circuit. In this receiver, however, not one part need be bought for the oscillator. This is accomplished through the use of a new oscillatory circuit in which feedback is provided by a homemade coil (L_5) placed in the common ground return.

A toggle switch mounted conveniently on the front panel controls the beat-frequency oscillations. In one position, the beat frequency is on. In the other, it is off. To receive code, the oscillator circuit is placed in continuous operation, while in receiving modulated carrier waves, such as those transmitted by broadcasting stations, the oscillator is operated only until the carrier squeal is tuned in. It is then turned off and the signal brought in by a slight readjustment of the tuning dial.

Outside of these novel, cost-reducing features, the circuit resembles the conventional superheterodyne. The tubes used are a type '57 mixer, a '58 oscillator, a '58 intermediate amplifier, a 2A5 second detector, and a 2A5 power amplifier.

Almost any type of well-filtered A and B eliminator capable of supplying 250 volts at fifty milliamperes for the plates and two and one half volts at seven amperes for the parallel-connected heaters can be used as the power supply. A voltage tap supplying 100 volts also will be necessary. If the available power supply is not so equipped, an external voltage divider having the proper tap can be connected across the 250-volt terminals. Incidentally, the 250-volt power unit recently described (P. S. M., July '34, p. 65)





Under side of the chassis showing the wiring and locations of the coils and other units

Superheterodyne

COMPACT AND ECONOMICAL

can be used for this receiver if it is altered in this way.

Your first step in constructing the receiver will be to provide the 2½- by 8- by 10-in. chassis. This can be purchased from your favorite parts dealer or you can cut and bend it yourself from No. 14 sheet aluminum by following the tips outlined last month (P. S. M., Oct. '34, p. 65). Although no front panel is shown or specified, one measuring the full width of the chassis and seven and one half inches high can be added easily. Two small bolts will hold it in place.

For ease of operation, the vernier tuning dial, trimming condenser (C_{11}), and gain control (R_4) are mounted on the front face of the chassis or panel. The isolantite plug-in coil socket, intermediate-frequency transformer, tuning condenser (C_1 and C_2), and tube sockets are mounted on the top face of the chassis while the regeneration control (R_8) is mounted on the right side of the chassis where it will be out of the way. The antenna, ground, and speaker terminals are placed at the rear and a hole drilled through the rear face takes the five-wire battery cable. The rest of the parts—the oscillator and beat-frequency coils, chokes, resistors, and fixed condensers—are mounted with the wiring in the 2½-in.-deep space under the chassis.

If care is taken in following the diagram, you should find it a simple matter to make a good job of the wiring. First of all, note that the return from the oscillator coil is not grounded directly but grounds through the feed-back coil (L_5). This is also true of the grid return from the second intermediate-frequency transformer, which grounds through the coil L_{12}.

When making the common plate-voltage and screen-voltage connections, be careful to connect the plate-return leads to the proper point on the multiple-section by-pass condenser (C_8). The choke (L_{11}) also should be mounted on this condenser section. The screen voltage returns should be wired in a similar way. By following this procedure, you will eliminate the possibilities of common coupling in the return leads and prevent troublesome oscillations. Finally, when wiring the electrolytic condenser (C_9), make the connections correctly according to the polarity (positive terminal of the condenser to the cathode of the 2A5 tube). *(Continued on page 79)*

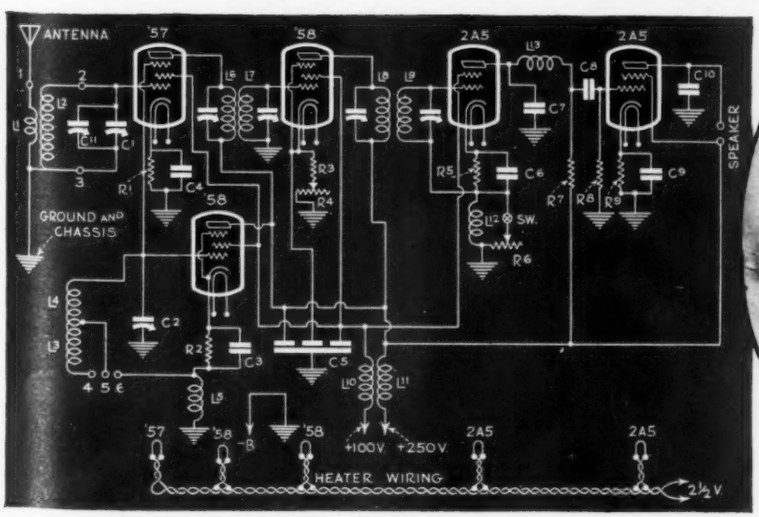
In spite of its compact design and economy of parts, this set is said to give good results on foreign stations

How the Coils Are Wound

Plug-in Coil No.	Freq. Range (megacycles -1,000 kc.)	Primary L_1	Secondary L_2	Oscillator Connections on Coil Prongs
1	8.5 to 16.5	6T. No. 26	*7T. No. 26	No. 5 to No. 6
2	4.5 to 8.5	7T. No. 26	14T. No. 22	No. 5 to No. 6
3	2.5 to 4.5	12T. No. 26	24T. No. 22	No. 4 to No. 6
4	1.5 to 2.5	16T. No. 26	47T. No. 26	No. 4 to No. 6

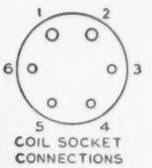
*Spaced to occupy a length of ¾".
Wound on 1¼ in. plug-in coil forms.

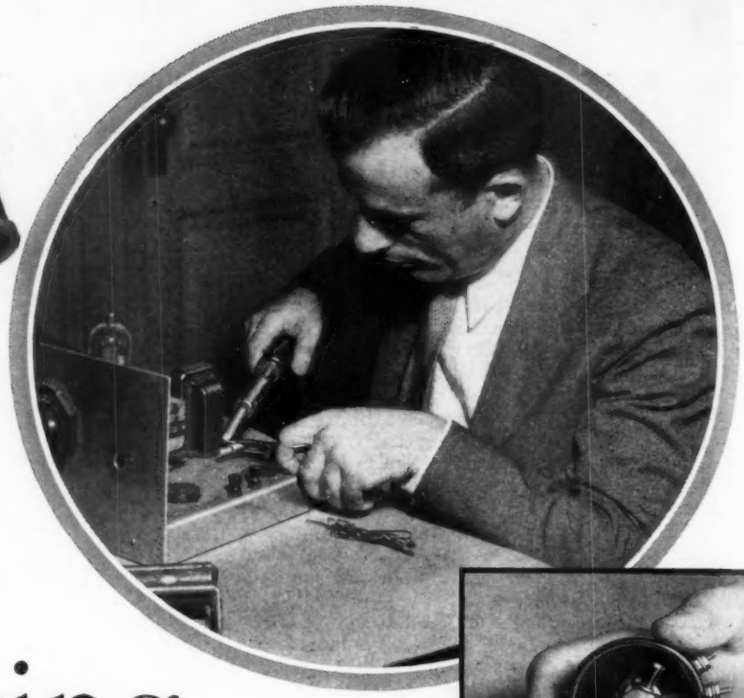
L_3.—77 turns of No. 30 } Wound on 1-in. tubing (3-in. long).
L_4.—12 turns of No. 26 } ¼ in. between windings.
L_5.—12 turns of No. 30 wire on ½ in. wood dowel.
L_{12}.—45 turns of No. 30 wire on 1-in. composition form 2 in. long.
All wire should be double-silk-covered.



Below, wiring diagram. Coil specifications are given at right

Shield removed from one of the air-tuned intermediate - frequency transformers to show its internal construction. The regeneration control knob is also shown mounted on right side of chassis





Above, altering the number of turns on a plug-in coil to make it cover the band range desired. To eliminate a squeal, known as a "fringe howl" connect a grid leak across the secondary terminals of first audio transformer, as at the right

Trouble Shooting

IN A HOMEMADE SET

By George H. Waltz, Jr.

WHEN you have trouble getting your homemade short-wave receiver to operate, don't get discouraged and condemn the circuit or doubt the quality of the parts. Nine chances out of ten, a wrong connection, faulty wiring, or a bit of stray resistance in the wrong place is all that is causing the trouble.

If the set fails entirely, your first job should be to check the wiring. However, merely comparing your connections with the diagram is not enough. It is too easy to skip over the same wrong connection time and again. Instead, make a new pencil diagram of the circuit as you have wired it and then compare this new drawing with the original. Any differences in the wiring will be immediately visible. Besides, making the circuit drawing will be excellent practice.

When you have checked and double-checked your connections, your next port of call should be the "A" and "B" supplies. Make sure that the filaments or heaters are lighted and test the batteries or power circuit for full voltages. Even if the set is dead to signals, a definite click should be heard when the earphones or speaker are connected or disconnected.

Because beginners in set construction invariably have some difficulty obtaining a neatly soldered joint, the junctions in your set should come in for special attention. Pull the wires to make sure they actually are soldered and not merely held in place by a hollow solder sheath or a lump of hardened flux. If you use paste flux, be particularly careful to see that each joint is clean and free from grease.

As a final attempt to make the set operate, have the tubes checked or substitute other tubes of the same type. Often a loose element or a broken connection inside the tube will cause all sorts of troubles. Of course, it is not beyond possibility that some faulty resistance or condenser has been included in the circuit. However, if you buy standard parts from a reputable dealer you can reduce this chance to a minimum. If a blown condenser or a shorted resistance has been wired into the circuit it generally can be located by the processes of substitution and elimination.

Failure to oscillate on the higher frequency is a common trouble with regenerative short-wave receivers. Generally, it is due to one of two causes: Either the coupling between the grid and tickler windings on the plug-in coils is not great enough, or there is too much radio-frequency resistance (due to long leads) somewhere in the grid circuit.

Lack of coupling may be due to a number of things, the most frequent being a reversed tickler winding. If both the grid and the tickler are wound correctly, they should proceed around the coil in the same direction with the top end of the tickler coil leading to the positive "B" circuit and the top end of the grid winding terminating finally in the grid of the tube. If for any reason, the two windings have been wound in opposite directions, or are connected to the plug-in coil prongs in such a way that the tickler is reversed, simply unsolder the tickler connections at the coil socket, reverse the wires, and resolder them in place. Reversing the circuit leads in this way will have the same effect as reversing the actually connections of the tickler winding to the plug-in coil prongs.

In illustration above a carbon type potentiometer is shown at top and a wire-wound type below it. Wire-wound type may give jumpy regeneration control

If the tickler has too few turns or is spaced too far from the grid coil, lack of coupling again will result. You can remedy this by adding a turn or a portion of a turn to the tickler winding, placing the additional turn on the grid winding side of the tickler so as to automatically decrease the space between the windings.

Home-built regenerative circuits, having a stage or two of audio-frequency amplification, often develop a howl when the set goes into or out of oscillation. This noise is called "fringe howl" and generally can be eliminated by experimenting with the value of the grid leak resistance. If this fails, a sure cure is to place a .1-megohm resistance across the secondary terminals of the first audio transformer.

Finally, a word about the mounting of parts on metal panels will not be amiss. This is particularly important in the case of a potentiometer used as regeneration control. Make sure that it is insulated from the panel unless otherwise specified in the diagram. If no ground is required, use either a potentiometer having an insulated shaft or provide the uninsulated shaft with an insulating washer on each side of the panel.

Question: Is it true that some spiders can fly? H. L. Nashville, Tenn.

Here's *the* Answer

A.—ALTHOUGH no record can be found of a species of spider having wings, most spiders can travel great distances through the air. They do this by spinning a long silken thread and launching it into the breeze so that it serves as a balloon or a parachute. Spiders and their ballooning silk threads have been found in the air hundreds of miles at sea.

An Old Navy Custom

J. W., CLEVELAND, O. The black scarf that forms an important part of a United States sailor's uniform is worn in memory of sailors who have lost their lives in the country's service. A knot is a speed of one nautical mile (6,080 feet) an hour.

And He Never Forgets

Q.—WHAT wild animal is the easiest to tame?—H. B., Detroit, Mich.

A.—ACCORDING to one well-known, wild-animal authority, elephants are the easiest to tame. Adult elephants have been known to be tame enough to be ridden after six days of captivity.

Aviation's Growth

G. H., SEATTLE, WASH. Since the Wright brothers flew their plane thirty-one years ago, more than 30,000 airplanes and 50,000 aviation motors have been constructed in the United States.

Most Plentiful Elements

Q.—PLEASE list the world's most plentiful elements in the order of their importance, taking into account the air and the water as well as the earth's crust.—A. E. J., Jr., New York, N. Y.

A.—AFTER a careful study, two United States Geological Survey scientists recently listed the following elements in the order of their abundance: Oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and magnesium.

A Long-Wearing Pump

Q.—WHAT is the pumping capacity of the human heart?—G. T., San Francisco, Calif.

A.—UNDER normal conditions, the human heart makes about 4,320 strokes an hour to pump fifteen gallons of blood through the veins. In the course of the average lifetime it makes approximately 2,592,000,000 strokes to deliver 9,000,000 gallons.

Steam-Heated Springs

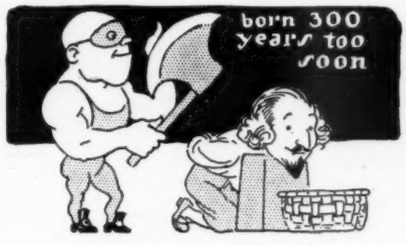
K. D. R., SALT LAKE CITY, UTAH. Hot springs and geysers such as those in the Yellowstone National Park are nothing more than steam-heated springs. For the most part, their water consists of ordinary surface rain- and snow-water, the actual heat being supplied by steam seeping up from buried lava beds beneath the earth.

Tea For Burns

L. J. N., ALBANY, N. Y. One of the oldest treatments for burns, and one which again has come to the fore, consists of bathing the skin with a strong brew of tea. The tannic acid in the tea is credited with soothing, scar-eliminating qualities.

Female Longevity

W. Y., CHICAGO, ILL. On the average, women live longer than men, enjoying sixty-one years of life to man's fifty-eight. The general span of life is increasing, however. In Queen Elizabeth's time, twenty years constituted the average lifetime.



Hot Sparks

Q.—IS THERE any truth in the statement that electricity is more deadly in summer than in winter?—E. M. J., Portland, Ore.

A.—ACCORDING to statistics compiled by life insurance companies, more deaths from electrical shock do occur in the summer than in the winter. Any effect of the weather on the potency of electricity is not blamed for this condition, however. More likely it is due to the fact that the average person generally has a coating of perspiration on his skin during the summer months. This makes the skin less resistant to electricity so that a moderately powerful shock that would not cause death in winter may be fatal in summer.

Coldest Man-Made Cold

Q.—WHAT is the lowest temperature ever reached by artificial means?—R. S., Kansas City, Kan.

A.—A NEW man-made low temperature of 459.6 degrees below zero Fahrenheit was reached recently by scientists at the University of Leyden.

Durable Aluminum

B. H. M., SEYMOUR, CONN. Although lighter than aluminum, duralumin is one of the strongest of the aluminum alloys. It consists approximately of 94% aluminum, 4% copper, 0.5% magnesium, 0.5% manganese, and smaller amounts of iron and silicon.

Aren't Two Enough?

Q.—IS IT common for a person to grow a third set of teeth late in life?—R. T., Harrisburg, Pa.

A.—ALTHOUGH far from being common, cases have been known where persons have grown a third set of teeth. In one such case, reported recently, a seventy-six-year-old woman not only boasted a third set of teeth but improved eyesight and darkening hair as well.

Or Jonah?

Q.—WHO WAS the first man to travel under water in a submarine?—K. L. J., Minneapolis, Minn.

A.—HONORS seem divided between William Bourne (English) in 1580 and Cornelius Van Drebble (Dutch) in 1624. Credit for the first wartime submarine goes to David Bushnell (American). Completed in 1775, it was used in the Revolution when an American seaman operating it tried unsuccessfully to attach an underwater bomb to the hull of the British man-of-war *Eagle*.

News for Manicurists

Q.—HOW FAST do fingernails grow?—M. G., Syracuse, N. Y.

A.—ON THE average, the external portions of fingernails are completely renewed once every ninety to 110 days.

Modeling Clay

A. N., BROOKLYN, N. Y. A permanently plastic clay for modeling can be made by mixing glycerin or turpentine with ordinary clay and adding vaseline to give the desired consistency.

Must Be From Missouri

Q.—CAN YOU outline a simple test that I can use to prove that the air consists of one-fifth oxygen?—K. O. P., Savannah, Ga.

A.—HERE'S a simple experiment anyone can perform. Wet the inside of a test tube with water and pour in a small quantity of iron filings. Then invert the tube over some water and allow it to stand for three or four hours. The change of color that takes place as the iron rusts and the increased height of the water level in the *(Continued on page 123)*

Watch Your Ammeter

. . . if you want to spot the start of ignition trouble and find other hidden ailments

By **MARTIN BUNN**

With a loop of wire Gus hooked a spring balance to the spring in the breaker arm. "Look closely," he said, "and you'll see that the balance reads about eighteen ounces"

"SOME people always want things in a hurry," grumbled Gus Wilson as he hung up the receiver and shoved the telephone away from him. Joe Clark, perched on one corner of the desk, grinned sympathetically. "What's the trouble now?" he inquired. "Somebody run out of gas?"

Gus shook his head. "It's Ted Cummings again. Something's wrong with his generator and as usual he has to have the car tonight."

Fifteen minutes later, the grizzled garageman had his gray head buried deep under the open hood of Cummings' car.

"Now let's get this straight," he said, fingering the black wires that snaked their way to the distributor. "When you started out this morning everything seemed to be O. K. and the ammeter was charging fifteen or eighteen amps. Then the pointer snapped over to the discharge side and it stayed there until you shut off the ignition."

Cummings nodded. "And it happened again coming over here," he said.

Gus placed his hand on the metal cylinder that housed the generator. "Suppose we try her again and see what happens," he suggested as he walked around to the driver's seat and turned the ignition switch. A glance at the ammeter showed the normal few amperes' discharge.

"So far, so good," commented Gus. "Now to step on the starter."

"Gosh," exclaimed Cummings as Gus opened the throttle and raced the motor. "She doesn't even show charge when you start now. That needle hasn't budged."

With a satisfied grin, Gus shut off the ignition and went back to the side of the motor. A few minutes later he loosened the clip that held a small cover plate to the side of the generator housing. As the plate dropped free and exposed the brushes and commutator, he tapped a small rectangular plate that was also visible.

"See that?" he asked, pointing with the tip of his screw driver. "That's your generator thermostat and unless I've got my signals crossed, that resistance you see mounted on top of it is burned out."

"A thermostat?" questioned Cummings. "I've heard of a thermostat in the radiator, but a generator thermostat is a new one on me."

"Not every car has one," explained Gus. "But this one does. It's like the gadgets they use to regulate a furnace or an electric iron. You know, a bar of metal that bends under heat and breaks an electric circuit.

"Well, the generator thermostat opens and closes according to the heat of the generator and the surrounding air. When the motor and generator are cold, the electric contact points of the thermostat are closed and full current from the generator goes to the battery. When the generator warms up, the two contacts spring apart, and instead of flowing to the battery, the current is side-tracked through this resistance and then to the battery. Naturally, the extra resistance cuts down the generator output and reduces the charging rate."

"BUT what makes you so sure the resistance is burned out?" inquired Cummings.

"From the way your ammeter acts, it's a cinch something is breaking the circuit when your motor warms up. A burned-out resistance would fill the bill pretty nicely, wouldn't it?"

"Then, how do you account for the way the ammeter acted a minute ago when you started the motor," asked Cummings. "It didn't even register charge in the beginning."

"That's easy," replied Gus. "Your generator was still warm from your ride over here. Naturally, the thermostat points were still open and the circuit from the generator to the battery was still broken. As a matter of fact, it was that little test that made me sure it was the resistance."

"Can you put in a new one?" inquired Cummings.

"Sure, but first we'll have to find out what made the resistance blow. Besides controlling the charging rate, that resistance is a generator fuse and when it burns out it's a pretty good sign there's a bum connection somewhere that's been overloading the generator."

ONCE again, Gus buried his head under the hood and proceeded to tug at the various wires that ran from the generator and the starting motor to the battery. "One thing certain," he announced at last. "We're going to find that bad connection somewhere in the charging circuit."

Gus soon found that a generator terminal had caused the trouble and a few minutes later he finished replacing the burned-out resistance and announced that the car was as good as new.

"That sure had me guessing," said Cummings. "Sort of mysterious, wasn't it, the way that ammeter would jump to discharge?"

"A car's ignition system is chuck full of mysterious troubles," replied Gus. "A fellow came in just the other day. Claimed his car had no pep, was hard to start, and heated up. After spending about two hours going over the ignition, spark plugs, and carburetor, I traced the trouble to the distributor. The spring that operated the breaker arm and points had got weak and wasn't forcing the contacts closed the way it should."

"How did you find that out?" asked Cummings.

Gus walked to his repair bench and picked up a *(Continued on page 121)*

A RAKISH *Privateer of* 1812

CAPT. E. ARMITAGE McCANN

scores again with a matchless model of a Baltimore clipper

Our new model, the *Swallow*, is 20 in. long and 13½ in. high over all. *At left:* Using a template

YOU'LL like our new ship model, the rakish little privateer *Swallow*. It is a model I, myself, have been wanting to build for a long while —a picturesque and unusual type of craft. The fact that the original ship was small, is a distinct advantage, because it enables one to work on a reasonably large scale and make a carefully detailed model, yet one that will not be too big for the average room. Here are all the essentials of a large ship without the repetition of numerous masts and yards with their gear.

The Baltimore clippers were probably evolved from the Jamaica-Bermuda sloops, possibly influenced by the French *chasse-marée* type of the mid-eighteenth century.

These clippers were the speediest ships afloat and consequently were much in demand for privateering and blockade running in both the War of 1812 and the Civil War. The pirates also favored them, and they were later used extensively in the slave trade. I have named this model *Swallow* after an actual 6-gun privateer of 1812. She was 92 ft. on deck by 24 ft. beam. Her bulwarks were pierced for 10 guns, and she was rigged as a top-sail schooner, as illustrated above.

The lines are from those taken off at Baltimore in 1820 by M. Marestier, a French naval engineer, and published in his book, *Memoire sur les bateaux a vapeur des Etats-Unis d'Amerique*. The sail plan is adapted from the same source. I am indebted to H. S. Chapelle for the valuable information on this type of vessel in his book, *The Baltimore Clipper*.

I am endeavoring to present this model so that it can be made in form and detail

How to clamp down the hull firmly in order to shape the deck to the proper sheer. The planks are marked in with a hard lead pencil

Nailing the keel. The effect of planking is obtained by drawing lines with a flexible straightedge and scratching them in accurately

equal to the very best models, or simplified to form a good project for the beginner, so will indicate parts that may be omitted.

My model is built to the scale of ⅛ in. equals 1 ft. of the original.

For the hull take four pieces of soft pine or other suitable wood (not balsa) 12 by 3¼ by 7/16 in. (which is the usual thickness of ½-in. dressed boards). Make a full-size drawing of the breadth plan or, if you are using blueprints, cut out the breadth plan or make a tracing of it. Scribe a center line down each piece. Pin the breadth plan on one piece of wood with the center lines coinciding. With carbon paper, transfer one line (say *a*) to the board and also mark the construction lines I to XI. Mark *b*, *c*, *d* similarly. Cut away the waste to within about 1/16 in. of these lines. With a try-square carry the side and center construction lines over the edges.

The model will be lighter and less liable to warp if you hollow pieces *b* and *c* to within about ¼ in. of the sizes of the pieces below them. All this can be done with the jig saw. Glue these together with all lines coinciding.

Onto stiff cardboard or other thin material, scribe the body plan lines as was done for the hull lifts, and make a template for each line, marking on them where line *b* cuts. After cutting these templates, place them on the body plan and test for accuracy.

Fasten the glued-up hull, bottom side up, by any convenient method. Screwing the top to a stick with octagonal ends to be held in vises is the best (see P.S.M., Oct. '33, p. 69), but holding in a bench vise or between the knees will serve.

First make templates from the sheer plan of the stem and stern, carrying them a few inches along the keel and marking on them the construction lines. Saw and file the hull to these lines.

Shave away the waste from the sides, making long cuts from the middle until all the templates fit accurately in their respective positions when held at a right angle to the keel line and mark *b* at the junction of pieces *B* and *C*.

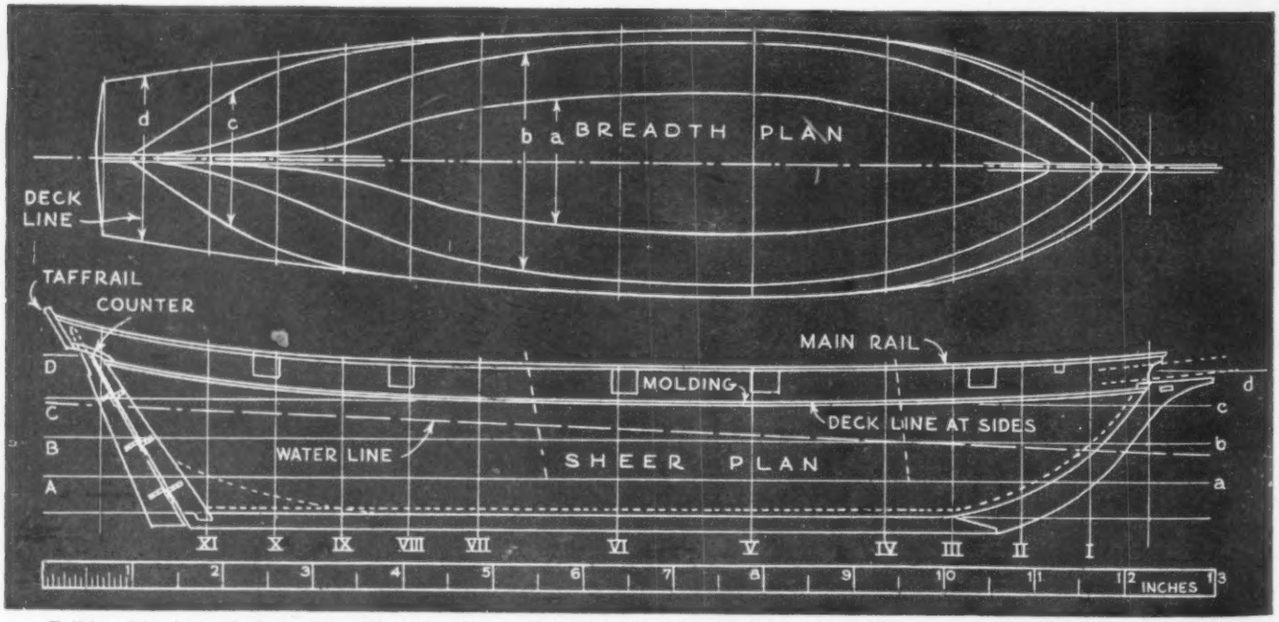
Leave a full ⅛ in. flat at the ends for the stem and sternpost to fit on. Bring the hull down exactly and sharply to the latter when fitted. The deadwood at the stern is flat and the same thickness as the keel, but leave it a bit thick until the latter is on.

A spokeshave will do most of this work, with the aid of a wood file at the bow and stern and any other tools, such as chisels and gouges, you may care to use. Remember that heavy sandpapering takes off an appreciable amount. Leave the final smoothing until ready to paint.

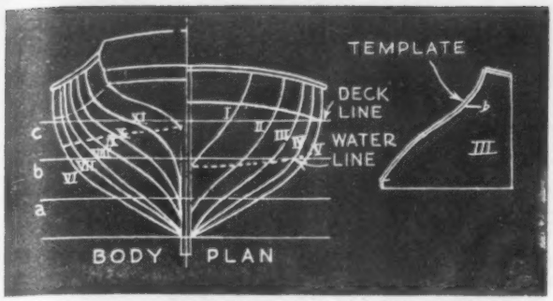
Set the hull upright on the bench. With a small, much curved model such as this, it is not easy to keep it firm, so I proceeded as follows: I made a working base or stand for the hull. The uprights were cut to the shape of templates IV and X, nailed to a board, and lined with cloth. I then got a block of wood the height of the hull at the stern, set the lower jaw of an adjustable clamp in the bench vise, and clamped down on the block and the baseboard with the end of the jaw projecting over the hull.

From the sheer plan mark the edge of the deck up from line *c*. Mark another line ⅛ in. higher than this for the curve across the deck. Set the hull in its base, and chisel and spokeshave or plane away the waste to the upper line. The wood will come out easier if you make a few cross saw cuts almost to the line. Shave

The taffrail drawn full size. It looks best if white on black, exactly like this



Full-breadth plan and sheer plan with station lines corresponding to those marked on the body plan given at the top of the next page. The deck plan with a side view of the deck fittings and a template for the bulwarks appear opposite. All drawings are to the same scale



The body plan from which templates should be made to aid in shaping the hull. A template for station III is shown

this part—the deck—until you have an even curve, meeting the underdeck line at the ends, but a full 1/16 in. higher at the widest part; then curve it down to meet the deck line at the sides all the way along. The standard curve of a deck is ¼ in. to the foot.

The stem, sternpost, and keel should go on next. From a piece of scant ⅛-in. hard or semihard wood, cut these to the shape shown on the sheer plan. The stem and keel should be set in a groove in the hull, which can be made with a wide saw cut and looks best if properly scarfed together, but it is less trouble to make the stem a bit long and cut it level with the bottom of the hull. Then set the keel under it and round off the end. The same applies to the sternpost. You do not then need to set the keel in a rabbet. Glue and lightly nail these parts on firmly.

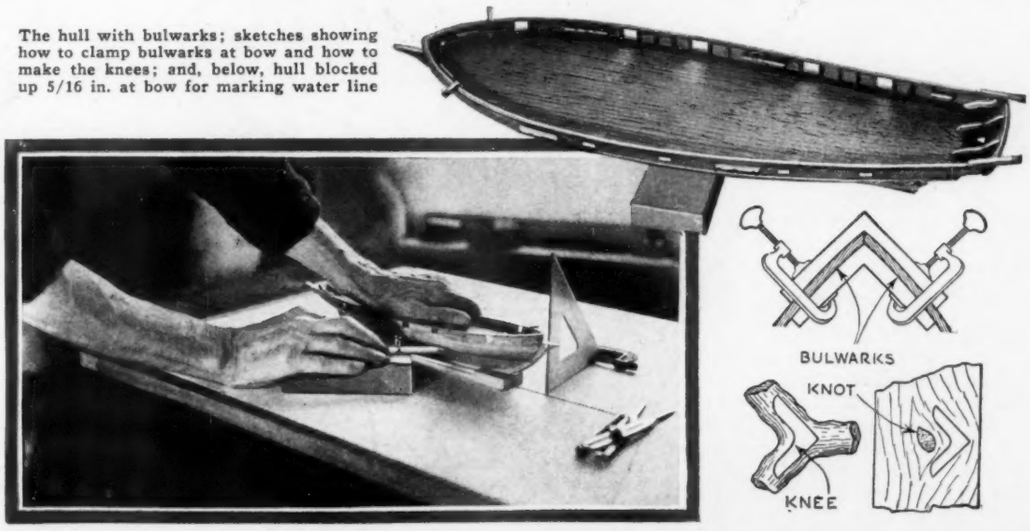
For the bulwarks, two pieces of wood that will work nicely, such as whitewood, gum, or holly, are needed. They should be 1/16 by ¾ by 13 in. First take a strip of cardboard, hold it or pin it outside the hull, flaring out at the bow and a little at the stern; and with a sharp pencil, mark the edge of the deck line on it. Draw a line ⅜ in. from this in the middle, but a shade wider at the ends. Cut this out, when it should be about like the bulwark piece shown, which should exactly fit the hull, but will not if your lines vary from the lines given. This principle applies to all parts. It is best to make templates first.

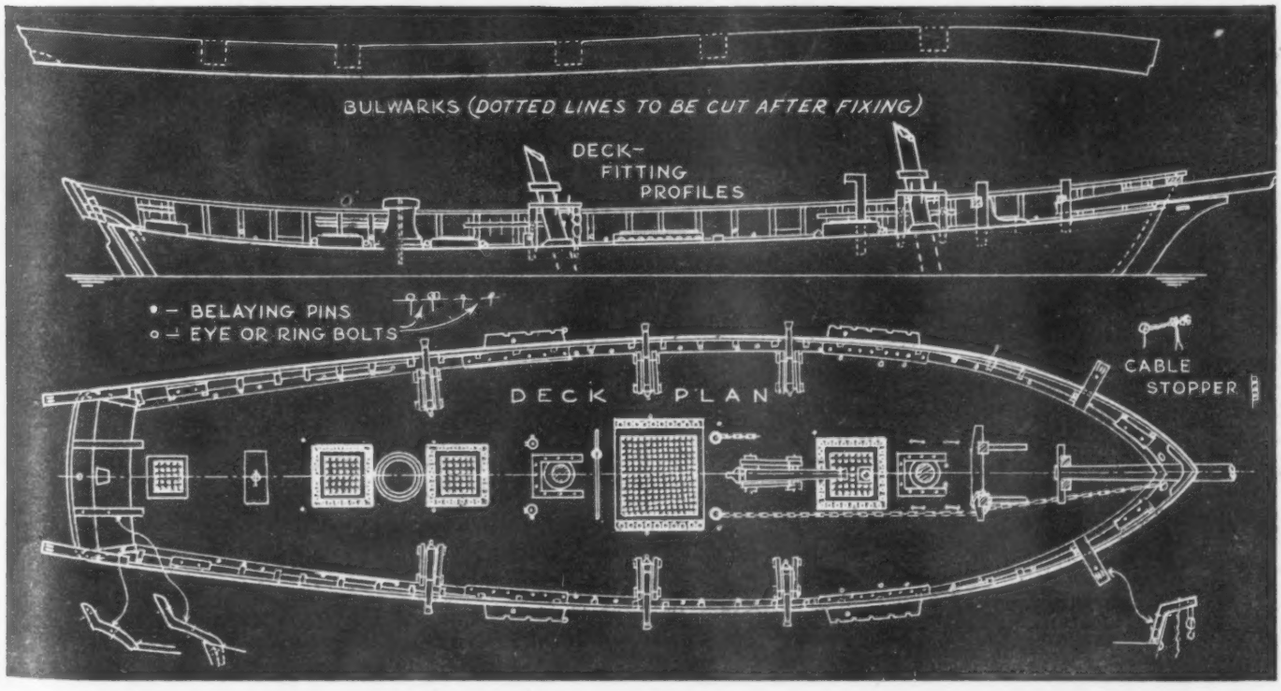
Having got the bottom line of the bulwarks right, cut your wood to it, but leave the top amply oversize. A slight bevel will be needed at the ends to allow the bulwark to fit flat on the deck where it flares out, as shown on the body plan. This piece goes onto the deck with its outside edge flush with the hull. The forward ends will probably need steaming to bring them to shape. If you have a kettle with a big spout, put them down that for a while; if not, soak them in boiling water for about twenty minutes, then bind them with a cloth around a coffee can and leave them to dry. Be careful to bend each one in the right direction.

While the bulwarks are drying, put in the waterways. These are strips of wood 3/32 by ⅛ in. wide. Make a pencil mark on the deck, in from the edge the exact thickness of the bulwarks, and glue and nail these strips to the deck, leaving what amounts to a rabbet for the bulwarks. The waterways will probably need steaming. They are cut to meet the inside part of the stem and extend right aft to follow the line of the stern.

To make a nice join at the stem, the bulwarks should be steamed a shade more round than needed. I let the first piece extend beyond the center line, stretched it along, and glued and nailed it in position, leaving an overhang aft. Then I cut it down on the *(Continued on page 102)*

The hull with bulwarks; sketches showing how to clamp bulwarks at bow and how to make the knees; and, below, hull blocked up 5/16 in. at bow for marking water line




BULWARKS (DOTTED LINES TO BE CUT AFTER FIXING)
DECK-FITTING PROFILES
• – BELAYING PINS
o – EYE OR RING BOLTS
DECK PLAN
CABLE STOPPER

A window exhibition of work by the Guild club in Elmira, N. Y. In addition, there was a particularly fine sailboat model, 4 ft. long, at the extreme right of the window

Official Magazine
POPULAR SCIENCE MONTHLY

Another Chance for You to

Join the

NATIONAL HOMEWORKSHOP GUILD

. . . Greatest of All Craftsmen's Clubs

IF YOU are not yet in the National Homeworkshop Guild, take the first opportunity this fall to join one of the clubs affiliated with it. You will miss a lot if you don't. A list of the cities and towns in which local home workshop clubs have already been established is given at the end of this article, and many more clubs are in the process of being organized.

The clubs from coast to coast are reporting renewed activities after their summer recess. Meetings are well attended, new members are coming in, and much work is being done in preparation for the various local exhibitions and for the first national exhibition and contest to be held in Chicago or some other centrally located city next March.

If you live in one of the places where a club has been organized, but do not know where the meetings are held, write to Guild headquarters, 312 Harper Avenue, Rockford, Ill., and the information will be sent you at once. Then make it a point to go to the next meeting, where you will be a welcome guest, and see for yourself how much you will be able to get out of constant association with other men who make a hobby of their home workshops.

"But I don't see my town listed," you may say. "Does this mean I can't become affiliated with the Guild?"

By no means. The thing to do is to enlist the aid of a few of your friends and form a club of your own. The Guild has purposely made the requirements for starting a club very simple. You need only four other enthusiasts beside yourself. Five or more amateur craftsmen anywhere, provided they are sixteen years of age or older, can organize a club and apply for a charter in the Guild. They will be entitled to all the benefits and services exactly as if their club had a hundred or more members.

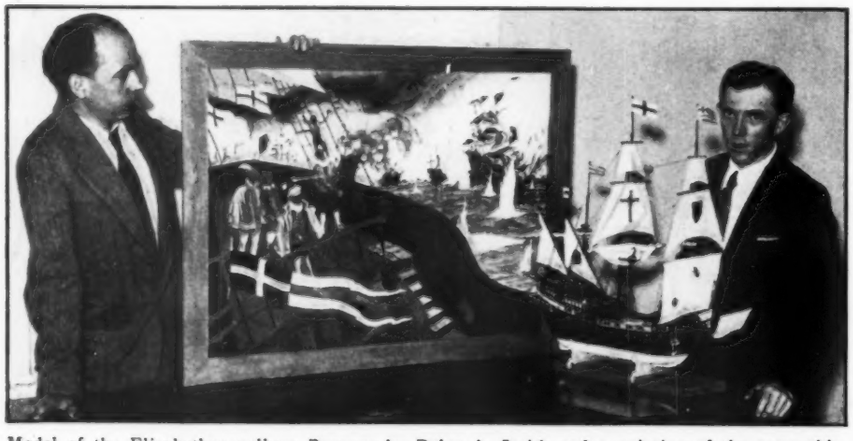
Two silver cups to be offered in the first National Guild Contest. One is first prize for the toy and novelty division; the other is first prize for club woodworking. Each will be accompanied by $100 cash

MEMBERSHIP REQUIREMENTS ARE FEW AND SIMPLE YET ADVANTAGES ARE UNLIMITED

There are a number of reasons why you should become affiliated with the Guild this fall. One is, of course, that the active season is just beginning. Another is that practically all the clubs will have local exhibitions of their work some time this fall or winter and you will therefore have an opportunity to prepare some good projects of your own to enter in these always very successful affairs.

A third and most important reason is that it will give you ample time to construct something to enter in the first national contest of the Guild. As announced last month (P. S. M., Oct. '34, p. 72), $2,000 in cash prizes and ten silver trophies will be awarded to the clubs themselves and to individual members. Most of these very liberal prizes will be for the craftwork of individual members, so the chances for a man in a small club will be just as good as for those who belong to the larger organizations.

If you belong to a club, you have the great advantage and constant stimulation of seeing what others are doing, of talking over your *(Continued on page 100)*



Model of the Elizabethan galleon *Revenge* by Delos A. Smith and a painting of the same ship by Donald L. Finch, of the Elmira club. The photo is used by courtesy of the Elmira Star-Gazette

NEW Auto-Driving Game

TESTS YOUR SKILL AT HIGH-SPEED STEERING

The object of the game is to steer the tiny auto so that it stays on the road and dodges all obstacles. The road is painted on a fast-moving endless belt

By *Paul* R. *Rannie*

HERE'S a new auto-driving game, packed full of thrills and excitement, that can be easily made and set up on the dining room table. A tiny car runs on an endless cloth belt, and you control its movements by means of a small steering wheel at one end of the game board. Marked on the belt is a curving road that appears to be coming toward you at 70, 80, or 90 miles an hour. Your opponent then drops small flat wooden blocks on the road at a fixed distance in front of the miniature car you are steering, and you try desperately to dodge them without running off the road. Whoever dodges the most blocks without a smash-up wins the game.

The device contains no complicated parts, and once constructed, no adjustments are required. The little automobile may be purchased for five or ten cents. The moving belt is ordinary heavy sheeting. Threads lead from the toy car to the steering wheel, but they do not require delicate adjustment because two small rubber bands maintain the proper tension at all times. You may rig up an electric fan motor to drive the belt if convenient, although it is almost as much fun if the belt is turned by hand, and the speed can then be constantly varied.

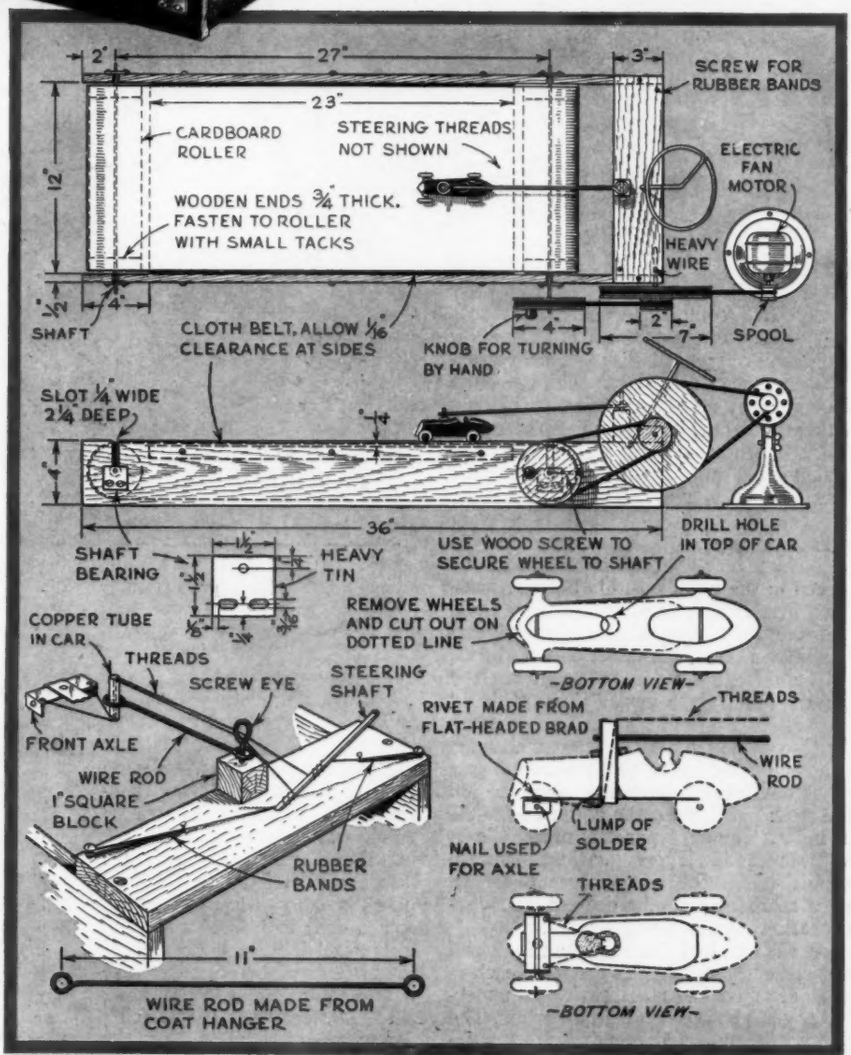
The general features are shown in the drawings. The only part of the construction that requires special care is in changing the little auto so the front wheels may be steered. The car should have rubber tires and a wheel base of 2½ or 3 in. It should be made of lead-like metal so that parts may be cut away with a knife. Remove the front wheels and the neighboring parts, and remount the wheels as shown so they may turn from side to side. A lump of solder is required on the underside as indicated for reducing friction at the point where the threads enter the upright tube. The tube should be about ⅛ in. inside diameter and 1½ in. long.

Rollers about 3 in. in diameter are easily made from large mailing tubes or the cardboard tube that is found on the inside of a roll of linoleum. Ordinary clothes line wire or No. 10 iron wire is used for shafts for the rollers. Slots in the heavy tin bearings allow the rollers to be adjusted.

The cloth belt should be hemmed on both sides. A road with curves and a car to pass are painted on with ink or water colors. Don't make too many curves or have them too sharp.

The steering wheel and mechanism are shown in detail. Solder the joints in the screw eye through which the control threads pass, otherwise the threads may get caught.

The drive wheel on the roller shaft and the spool on the fan-motor shaft are held with wood screws used as set screws. Belts for the driving wheels are made of rope with the ends sewed together. They may be prevented from slipping on the small pulleys by placing one or more rubber bands around the *(Continued on page 117)*

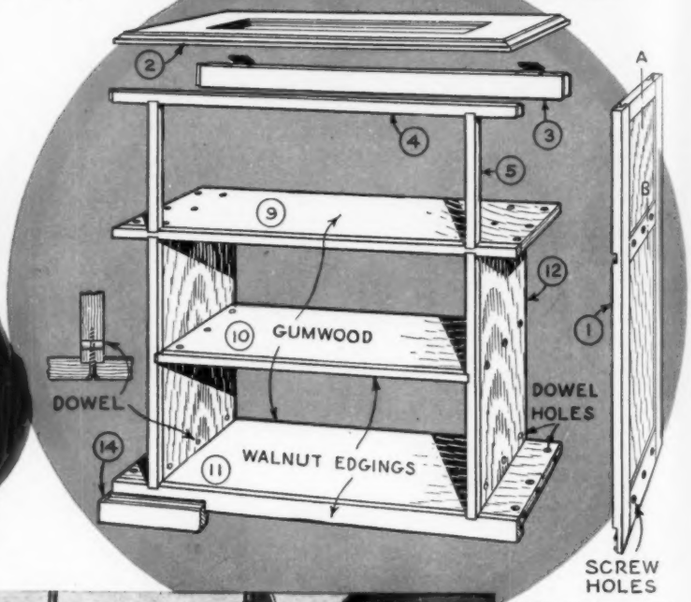


Top and sides views of the assembled game, how the steering threads are arranged, and three views of the toy auto as modified. The endless belt may be turned either by motor or by hand

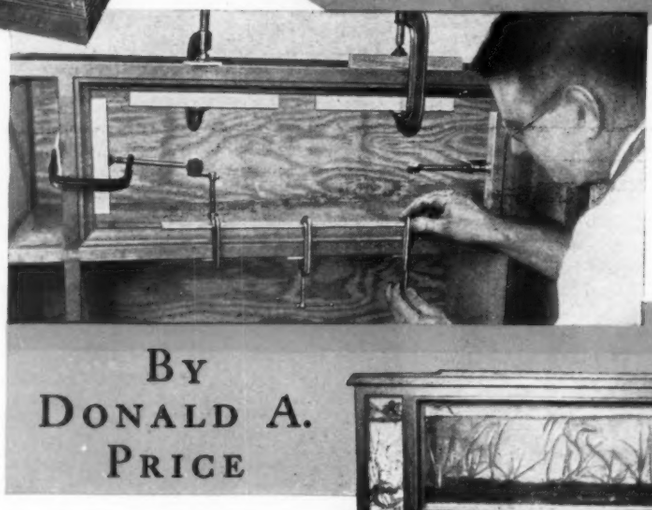
Illuminated Aquarium

SET IN BOOKCASE

The aquarium is lighted from the ends by two lamps set behind panels of frosted glass, which bear paintings



General method of assembly, one way to make the sides, and frame for the lid. The latter, however, may be made solid



At left: Gluing and clamping the molding around the front opening of the aquarium holder. *Below:* Completed piece

By Donald A. Price

THIS combination aquarium-bookcase forms a beautiful setting for goldfish or tropical fish. The tank—never a particularly sightly object—is so framed that it is practically hidden. When the lights are lit at night, the colorful little fish are seen in a gorgeous, ever-changing pageant. Decorative transparent panels at each end heighten the unique and brilliant effect.

Even in daylight the fish are displayed to advantage. The aquarium should be placed in the usual position before a window, just as if it were an ordinary tank, and the light then shines through and illuminates the whole upper compartment.

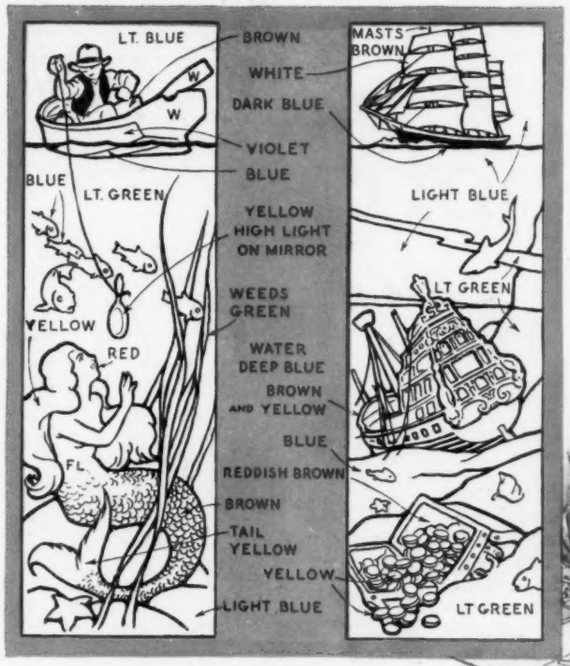
The tank is set on the upper shelf *9* and covered by the hinged lid *2*. This lid was originally made with a plate glass panel over the tank, but was later changed to a solid wood panel, as it was found that objectionable condensation occurred on the glass panel when the house cooled off at night. The glass panel is preferable in appearance; and if the aquarium bookcase stands where the temperature does not vary more than a few degrees, the condensation would be negligible.

At each end of the aquarium is placed a small electric light. In front of each is a panel of frosted glass having an underwater scene painted on it in oil colors. The lights are connected in parallel and provided with an extension cord long enough to plug into the nearest outlet. A switch on the back panel of the bookcase enables you to turn off the lights without pulling out the plug. Back panel *15* extends up only to the shelf *9*, leaving the back open to the light in the daytime. This is necessary for the health of the fish, and it also shows off the paintings in daylight.

The dimensions may be altered to accommodate any long, narrow tank. You may use one on hand, buy one ready-made, or build one yourself. Drawings near the end of the article show how the ¾ by ¾ by ⅛ in. steel angles used in making this tank were joined at each corner. If the separate pieces are cut to size before taking them to a welding shop, you may get the welding done for a small charge. Test the tank for leakage for several days before installing it in the bookcase.

For convenience in describing the construction, it is assumed that walnut is to be used, although any suitable cabinet wood, of course, may be substituted. The work may be reduced at some sacrifice of appearance by making ends *1* and lid *2* of solid walnut or of 13/16-in. thick walnut plywood, instead of paneled. If plywood is used, the front edge of ends *1* should be covered with walnut about ⅛-in. thick, glued on to conceal the core. Also, if the lid is made of one piece of plywood, it may be dressed to a size of 12 by 33¾ in., and strips of solid walnut ¾ in. wide may be mitered at the corners and glued

Unique New Piece of Furniture Is Beautiful Setting for Tropical Fish

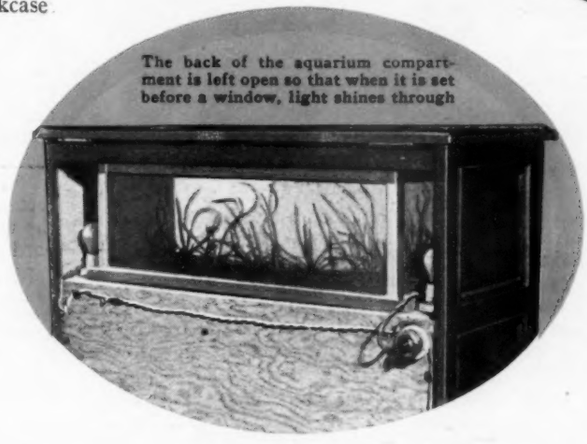


The scenes for the ground-glass panels at each end of the aquarium. These should be enlarged to 2 15/16 by 9 5/16 in. The glass is then laid over them and the designs traced with a brush

on each edge to build it up to the required size and to provide stock for molding the edge.

If it is decided to build up ends *1* as panels in the way shown, the machining of the composite parts of the panels may be done very simply by using the dado head set to cut a ¼ in. wide groove. This groove is run entirely along one edge each of the side, top, and bottom rails and along both edges of the middle rail, ¼ in. from the face side. The cross rails have ¼ in. thick tenons on each end that fit in the same groove in the side rails in which the ¼-in. three-ply walnut panels are inserted. The projecting panel molding is fitted and glued in place after the bookcase has been completely assembled.

The front edges of the shelves and partitions, which can be made of gum or clear pine, are edged with about ¾ in. of walnut. The lower shelf, marked part *11*, has a 1 13/16 by 13/16 in. walnut front piece, which is rabbeted out and glued on the main part of the shelf. This is put on before the piece is trimmed to finished dimensions. Section *B*, near the end of the article, shows the method of fastening the case together. The ½-in. dowels should first be glued in the proper places to take the screws, and the projecting ends carefully trimmed off flush.

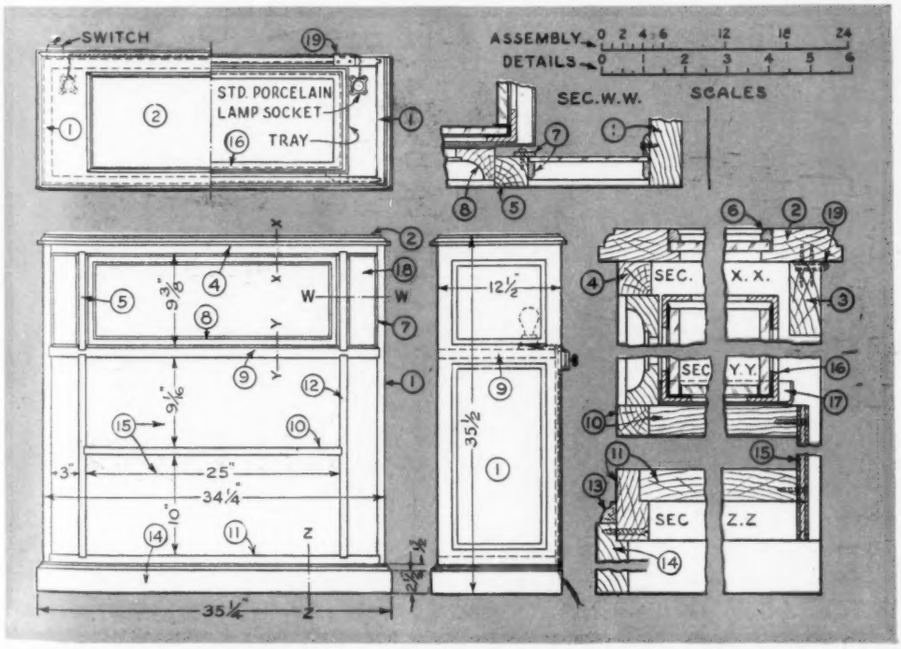


The back of the aquarium compartment is left open so that when it is set before a window, light shines through

Now the 3/16 by 13/16 in. grooves should be cut in their proper locations on parts *1, 4, 9, 10, 11,* and *12*. This may be done efficiently with the aid of the dado head on the saw table, or by using the circular saw itself, taking several cuts for each groove. At this time also cut the ¼-in. grooves in end panels *1* to take back *15*, and the grooves or mortises at the top to take top rails *3* and *4*. Drill and countersink the clearance holes for the 1½-in. No. 8 flathead screws. The screw holes in ends *1* should be counterbored ½ in. in diameter and about ⅜ in. deep for wooden plugs.

The assembling is done in the following order: the vertical partitions *12* are screwed to middle shelf *10*; upper shelf *9* and lower shelf *11* are screwed to partitions *12*; then side panels *1* are screwed to shelves *9* and *11*. Make a trial assembly first without glue. When the final glued-up assembling is done, have someone help you so that the work may be completed before the glue in the first joint has had time to set. Glue in place the concealing plugs over the screws in the ends, making sure the grain in the plugs runs in the same direction as in the surrounding wood. Then, at your convenience, glue in place top rails *3* and *4* and vertical posts 5. These last may be bradded in place in addition to being glued.

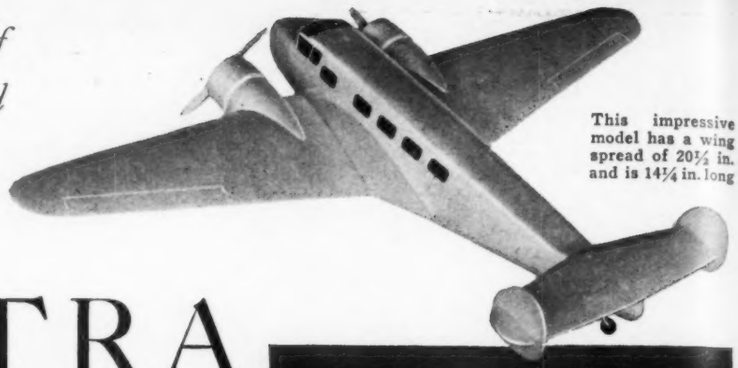
Trim off all the flush joints and clean off the excess glue by care- *(Continued on page 98)*



The general construction. Sizes of all parts are given in the list of materials, but detailed dimensions have been omitted because most builders will wish to make modifications

Whittled Model of New High-Speed

Transport ELECTRA



This impressive model has a wing spread of 20½ in. and is 14¼ in. long

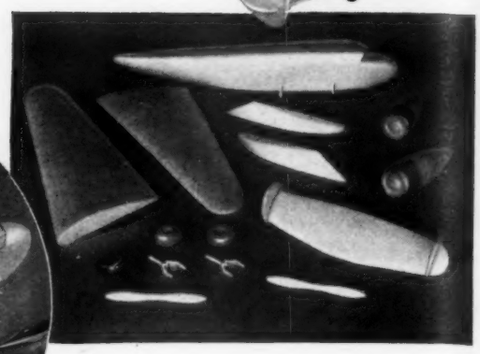
By Donald W. Clark

ONE of the most graceful large monoplanes is the new high-speed, all-metal, twin-engined transport, the Lockheed Electra, model 10A. This plane can travel 221 M.P.H. at 5,000 ft. altitude and has a cruising speed of 203 M.P.H. Its comfortable cabin holds ten passengers. A fleet of these ships has been ordered by Northwest Airways to reduce flying time over its northern transcontinental route.

The clean-cut lines of this plane should stir any model builder to enthusiasm. The scale of the model in relation to the real airplane is ⅜ in. equals 1 ft.

Only seventeen units are required. The hardest task is tapering the wings and carving the wing stubs or fillets.

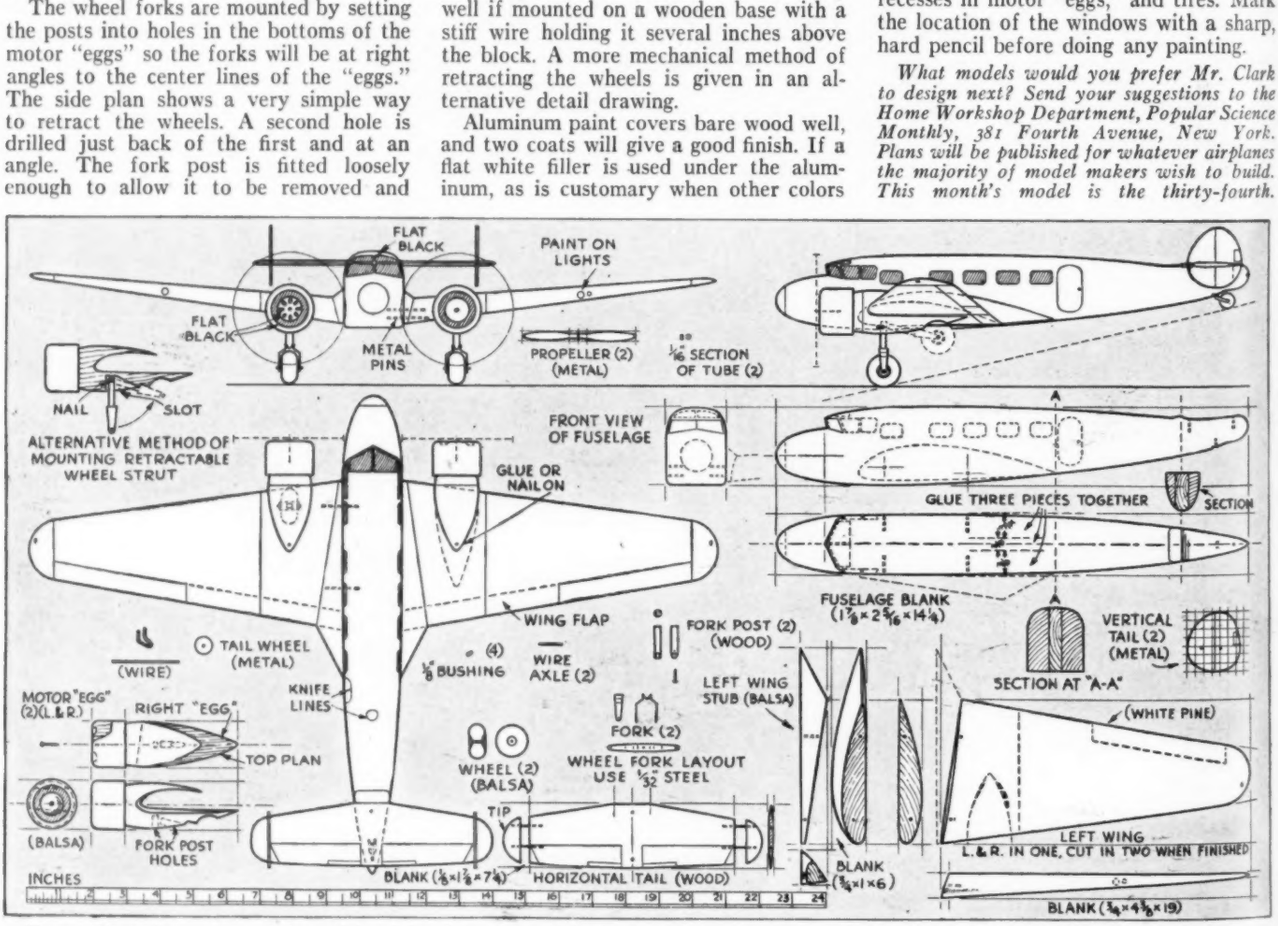
The wheel forks are mounted by setting the posts into holes in the bottoms of the motor "eggs" so the forks will be at right angles to the center lines of the "eggs." The side plan shows a very simple way to retract the wheels. A second hole is drilled just back of the first and at an angle. The fork post is fitted loosely enough to allow it to be removed and pushed into the rear hole. With the wheels in this position the model will show up well if mounted on a wooden base with a stiff wire holding it several inches above the block. A more mechanical method of retracting the wheels is given in an alternative detail drawing.



In spite of its size, the model requires only these seventeen comparatively simple units. *At left:* Fastening tail unit to fuselage. Note also the assembled wheel forks and their posts

Aluminum paint covers bare wood well, and two coats will give a good finish. If a flat white filler is used under the aluminum, as is customary when other colors are to be applied to a model, the aluminum may loosen later on. Therefore give the entire model two coats of aluminum paint, and use flat black for the windows, recesses in motor "eggs," and tires. Mark the location of the windows with a sharp, hard pencil before doing any painting.

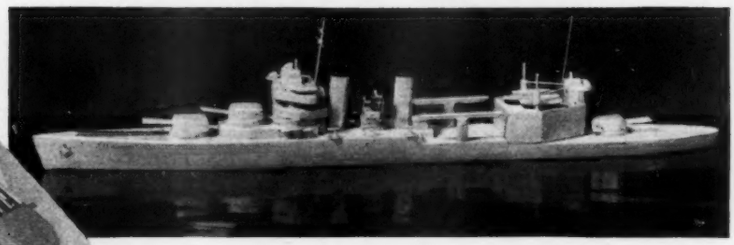
What models would you prefer Mr. Clark to design next? Send your suggestions to the Home Workshop Department, Popular Science Monthly, 381 Fourth Avenue, New York. Plans will be published for whatever airplanes the majority of model makers wish to build. This month's model is the thirty-fourth.



Front, side, and top views of the model and detail drawings of the fuselage and other parts. Dimensions may be found with the aid of the scale. The wings are shaped from one long piece of wood and cut apart afterwards. The horizontal tail is also completely shaped before cutting the tips

MINIATURE WATER-LINE MODEL OF THE

New Battle Cruiser *Tuscaloosa*



Two views of a very easily made balsa wood scale model of the U. S. S. *Tuscaloosa*. The model is 11¾ in. long over all and was designed especially for the Popular Science Model-of-the-Month Club. Membership in the club is free to anyone who buys a Model-of-the-Month construction kit

MODEL of the MONTH

Number Four

DESIGNED BY

Theodore Gommi

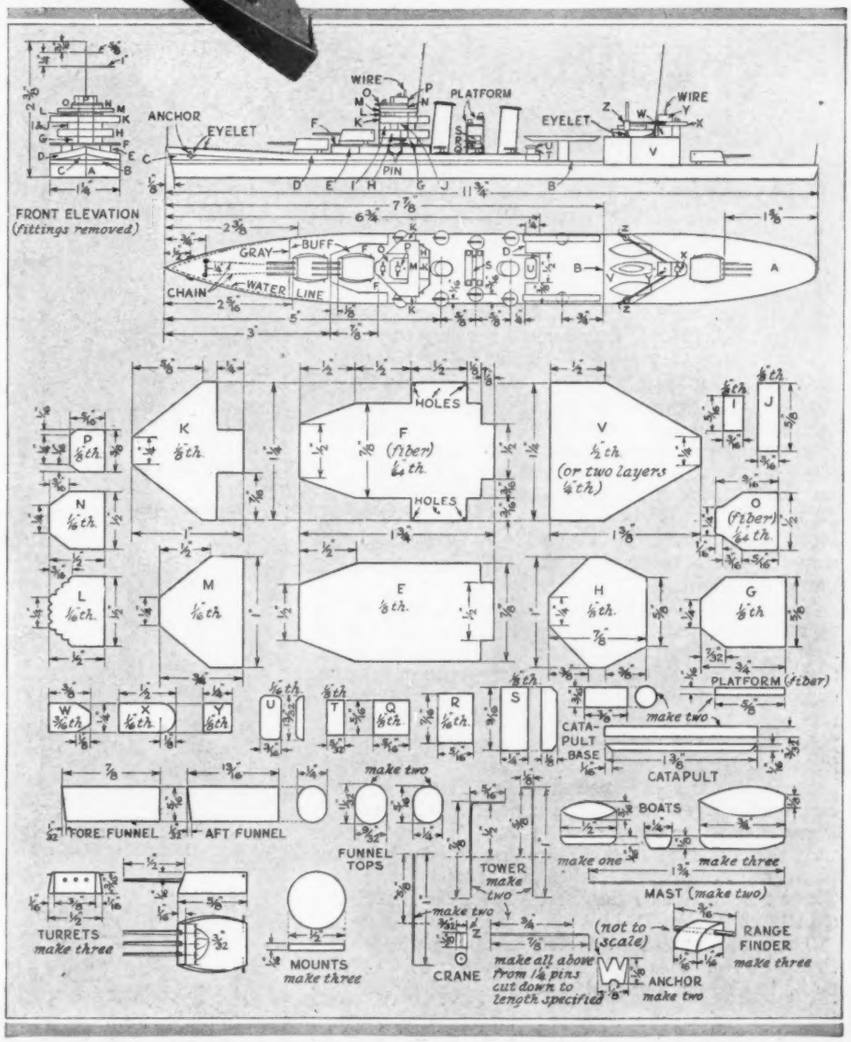
OUR Model-of-the-Month project for November is the new 10,000-ton cruiser *Tuscaloosa*, which has just been commissioned at the Philadelphia Navy Yard, prior to her shakedown cruise.

Many improvements have been incorporated in the design of this ship, which is the latest addition to the United States Navy, and she is noticeably more graceful than earlier cruisers in the same class. She is 578 ft. long at the water line, 66 ft. wide, and carries nine 8-in. and eight 5-in. guns as her main armament.

This model, built to the scale of 1 in. equals 50 ft., is simple to make in spite of its intricate appearance. As in previous models in this series (see particularly P.S.M., Aug. '34, p. 69), all the main parts are cut from balsa wood of the type used in model airplane construction. The minor parts are made from fiber, dowel sticks, pins, eyelets, washers, wire, and very fine chain.

The ease with which the model can be constructed is due to the unique layer-built construction. The hull, for example, consists of 1 pc. balsa ¼ by 1¼ by 11¾ in. for *A*, 1 pc. 1/16 by 1¼ by 7⅞ in. for *B*, 1 pc. ⅛ by 1¼ by 2⅜ in. for *C*, and 1 pc. ⅛ by 1¼ by 6¾ for *D*. The various units of the superstructure are also built up from simple parts.

A complete construction kit that contains all the materials, including three bottles of enamel and one of cement, a blueprint showing all parts full size, a bulletin with detailed instructions, and an itemized list of materials giving the finished sizes of all parts, will be sent to any reader for $1, postpaid. A coupon is given on page 9 for your convenience. The blueprint and instructions alone may be obtained for 25 cents. Order Blueprint No. 234. Regular members of the Model-of-the-Month Club, to whom certificates have been granted, may have the detailed instructions free upon application, provided they inclose a self-addressed and stamped envelope.



Assembly views of the model and details of superstructure units and various small parts. For clearness, the details are drawn to a scale twice that used for the assembly views

BLUEPRINTS for Popular Science Monthly projects are listed on page 88.

THE SECRET OF

Making Lifelike Portraits

Simple Method of Balanced Lighting Gives Photos Equal To Those of Movie Stars

By ALBERT J. HURST

Fig. 1. The amateur photographer can take portraits of this fine quality if he knows how to balance the lighting

IF YOU know how to handle your lights correctly, you can take brilliant, lifelike camera portraits. Without that knowledge you will never get, except by some lucky chance, anything better than a mere photographic reproduction. And there is all the difference in the world between the two.

It is not merely a matter of following a lighting diagram, scores of which are to be found in photographic manuals and on special portrait charts sold for the purpose. You need to know more than a diagram tells you. It is essential to understand what effect each type of light has on the subject when used alone, and how to combine the lights to give exactly the result desired.

You would be handicapped, of course, but for the fact that the new and improved photographic materials used by professionals are now also made in the amateur sizes. The foremost of these materials is panchromatic film. This makes it possible to take a picture with a far slower lens and less light than was possible with the old-style film. The results with this film may be discouraging at first, but that is merely because it must be handled in a different manner. Proof of the excellent results possible can be seen every day in the movies. It is through them, by the way, that the public has acquired its growing taste for photographs done in a higher and more brilliant key. These results can be duplicated by the amateur with a little effort.

The most important factor in taking portraits is light balance. This balance of light is produced by a two-, three-, or four-light source instead of a single light and a reflector.

The first light source to consider is what may be called the "flat light." It may be a single large clear bulb with a diffusion screen or it may be composed of a number of smaller white-frosted bulbs. The latter is more economical in both first cost and efficiency, but the important thing is to get a soft, diffused light that will cast no sharp shadows.

Fig. 2. How the subject looks with only a flat illumination from in front

Fig. 3. The effect produced by the high-light lamp when used by itself

Fig. 4. Flat light and high light used together. *Below:* Lighting diagram

The flat light is placed next to the camera as shown in the diagram, and on the same level as the lens. The ideal condition would be to have two such lights, one on each side of the camera. In Fig. 2 the subject is lighted with only the flat light. Notice the absence of any high lights or muddy shadows, and the low intensity of the illumination.

Figure 3 shows the subject lighted by the second source of light, which produces the high lights. *(Continued on page 82)*

●

$50 in Prizes FOR Amateur Photos

HAVE you taken any especially good pictures recently? If so, we should like to see them. To make it worth your while to send them in, we offer the following prizes without any restrictions in regard to size or subject matter:

FIRST PRIZE	$25
SECOND PRIZE	15
THIRD PRIZE	5
FIVE PRIZES, $1 each	5
TOTAL	$50

All you need do is send in one or more of your best prints. Mail them to the Photographic Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than December 1, 1934, and mark your entry "November Photo Contest." It is not necessary to send the films.

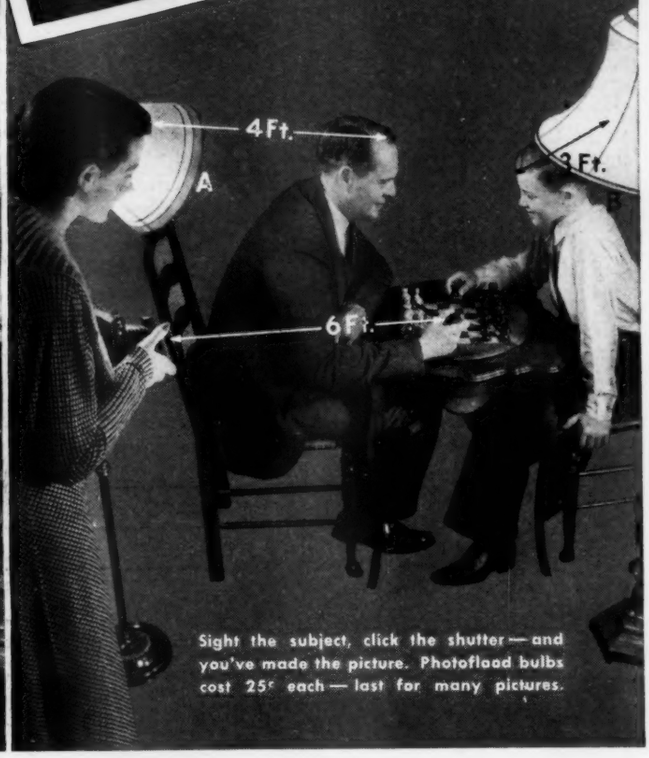
Write on the back of each print your name and address and what type of lighting was used—davlight, photoflash bulbs, photoflood lamps, or other artificial illumination. No prints will be returned unless a self-addressed, stamped envelope is inclosed. The contest is open to any *amateur* photographer except employees of POPULAR SCIENCE MONTHLY and their families. The developing and printing, of course, may be done by a professional unless you prefer to do it yourself. In case of ties, each tying contestant will be awarded the prize tied for.

●

Take snapshots like this— AT NIGHT!

IT'S EASY TO MAKE THIS PICTURE

Use Kodak "SS" Film. Set your camera for 1/25 second — open lens diaphragm to *f*.6.3. Put 1 Mazda Photoflood bulb in lamp A— 2 in lamp B. Distances as indicated.



Sight the subject, click the shutter — and you've made the picture. Photoflood bulbs cost 25¢ each — last for many pictures.

with Eastman's new high-speed "SS" Film

● Cameras have been given new vision. You can take snapshots indoors . . . *at night!* What a wealth of new picture opportunities. The fireside scenes —the parties—the children at their indoor games.

Use a camera with an *f*.6.3 (or faster) lens, loaded with Kodak Super Sensitive Panchromatic Film.

This high-speed (extra sensitive) "SS" Film does the trick—it's three times as fast as ordinary film when used under artificial light.

For light, use two or three Mazda Photoflood bulbs. Just hold the camera in your hands, set for 1/25 second, lens at *f*.6.3 opening, and click the shutter.

For indoor pictures at night with slower-lens cameras (including box models) use Verichrome (or "SS") and a Photo*flash* bulb—see free folder—with camera set for "time" exposures.

FREE FOLDER . . . Complete instructions on indoor night photography. Photo*flood* snapshots . . . Photo*flash* pictures . . . all are covered in this free folder. At your Kodak dealer's—or write for your copy today. Eastman Kodak Company, Rochester, New York.

KODAFLECTOR—Inexpensive, efficient, sturdy, easy to use . . . makes 2 Photoflood bulbs do the work of 9. Complete, with folding stand, reflectors and cord, $5.

KODAK "SS"—the lightning-fast film, with the green lightning flashes on the familiar yellow box—the film that indoors or out, in any light, improves picture quality.

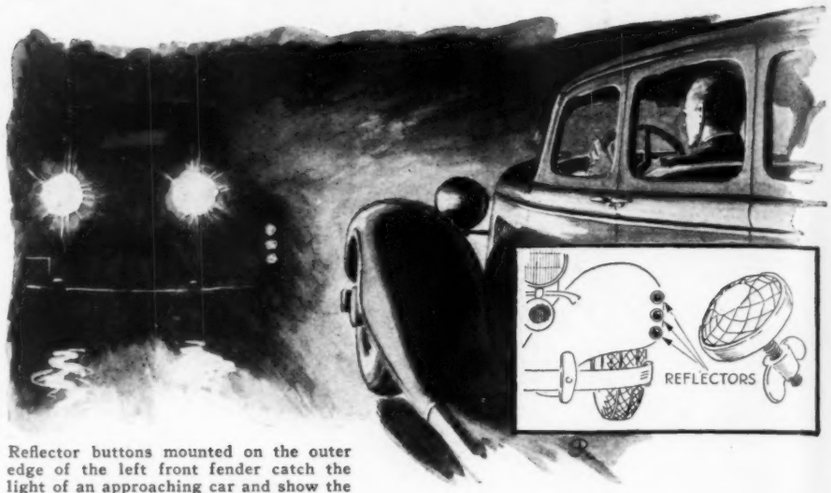
KODAK SIX-20 with Kodak Anastigmat lens *f*.6.3 is ideal for night snapshots. Pictures 2¼ x 3¼ inches, price $17.50. Kodak Six-16, with *f*.6.3 lens, pictures 2½ x 4¼ inches, $20.

IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK

Helpful Kinks *for* Your Car

New Ideas for Repair and Operation from Our Readers

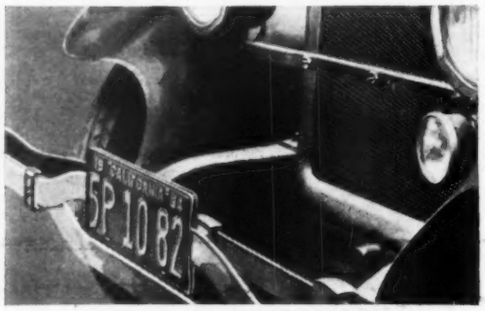
THE danger of sideswiping due to headlight glare can be reduced by mounting small red reflector buttons on the outer edge of your left front fender. Reflecting the light from approaching headlights, they mark the outer edge of your car. Any red glass reflectors of the type sold as license-plate mounting bolts can be used. They can be mounted in holes drilled in the fender or they can be provided with spring clips.—H. V. L.



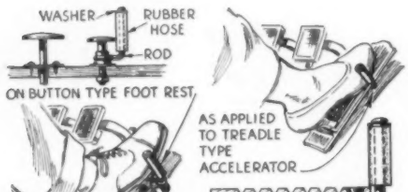
Reflector buttons mounted on the outer edge of the left front fender catch the light of an approaching car and show the driver how far over your fenders extend

Old License Plates Mount New Ones

A SIMPLE, inexpensive front-bumper mount for a license plate can be had by utilizing an old discarded plate from the year before. The new plate is placed in front of the bumper and the old one, reversed to cover the figures, is placed back of the bumper. The two are fastened together with four small bolts run through the regular mounting holes. Strips of inner tubing placed between the plates and the bumper will prevent any annoying rattles from developing.—H. M. H.



Last year's license plate will furnish a mounting for the current one, if the two are bolted to the bumper

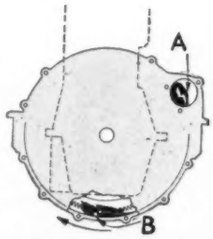


Guides Foot to Throttle

AN EASILY-MADE foot guide for the accelerator consists of an iron rod bent L-shape, provided with a loop to fit over the mounting bolt on the foot rest, and fitted with a short length of rubber tubing. The same idea can be applied to the treadle type of accelerator by mounting the guide on the right hand edge of the flat pedal with a bolt as indicated in the illustration.—E. T.

A New Use for Grease

IF A starter spring bolt or a similar part breaks, nine times out of ten it will drop into the flywheel and clutch housing. To open the under-motor at this point presents a troublesome problem, but the parts can often be removed by making use of a handful of heavy grease. The grease (A) is placed on the flywheel and the motor is cranked by hand. The parts (B) will become embedded and, by careful cranking, can be carried around to the starter opening where they can be removed. Continue "fishing" until you are sure all of the parts have been retrieved and remove all traces of the grease from the flywheel to prevent gumming the starter motor spindle and gear.—G. P.

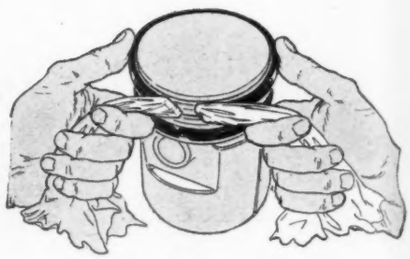


Broken parts can be taken from the clutch housing with grease

Killing Wheel Squeaks

SINCE the squeaking of wood wheel spokes is caused by dryness of the wood, tightening the spoke bolts is usually ineffective. A better cure is to brush on as much hot raw linseed oil as the wood will absorb. This will stop the squeaks and help to prevent further drying of the wood.—K. M.

Squeaking of wood wheels, caused by dryness, can be stopped by brushing on as much hot linseed oil as possible



Simple Ring Expander

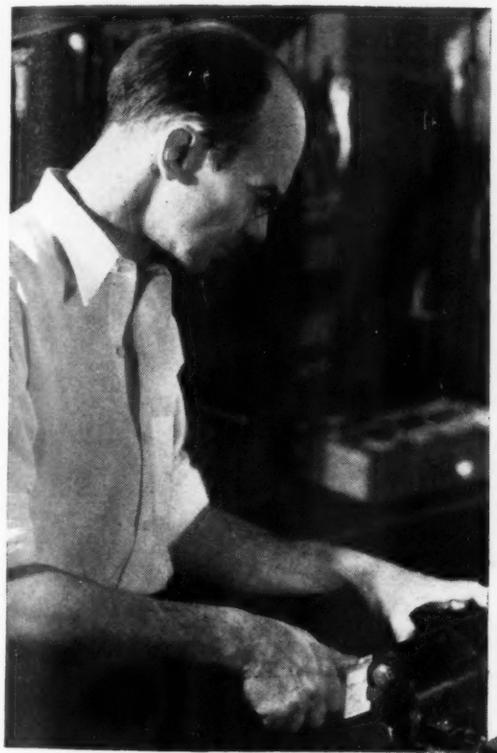
FOR installing piston rings, a simple expander can be had by making use of two pieces of heavy cloth as shown. One end of each cloth is hooked over the ends of the piston ring at the split and provide enough purchase to allow the ring to be pulled apart. Once the ring is in place, the cloths can be freed.—J. C.

Fixing Windshield Wiper

OFTENTIMES, a faulty vacuum-type windshield wiper can be fixed by turning it on and holding the wiper arm in one position against the force of the air-driven piston. The air leaking through the wiper motor loosens the valve and the piston.—H. P.

MUSIC CAN HAVE ITS FLATS

BUT TOOLS MUST BE SHARP



DEEMS TAYLOR

... says Deems Taylor

FAMOUS AMERICAN COMPOSER

The world knows Deems Taylor as a great musician, but few know that he is just as much at home in front of a lathe as he is at a piano. Skilled and versatile, Mr. Taylor's talents as a craftsman range from the making of fine period furniture to the building of a front porch (faithfully copied from a Colonial house) for his home in Stamford, Connecticut.

Above—Carborundum and Aloxite Brand Wheels for general metal work and tool grinding. All standard sizes and grits.

Left—Combination Bench Stones—one side, coarse grit for nicks; reverse, fine grit to bring tools to a perfect edge. Priced from 85c. to $1.50.

"MUSIC can have its flats," says Mr. Taylor, "but tools must be sharp. Cutting tools are meant to cut and unless you keep them razor-sharp all the time, no amount of skill will enable you to do good work with them. I do a lot of wood-turning at high lathe speeds; and a fast lathe and a dull chisel are an ideal combination for ruining a piece of wood in no time.

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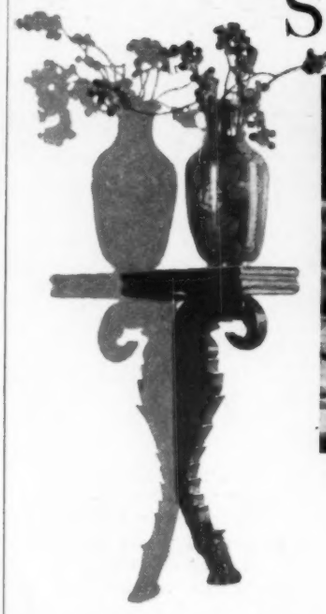
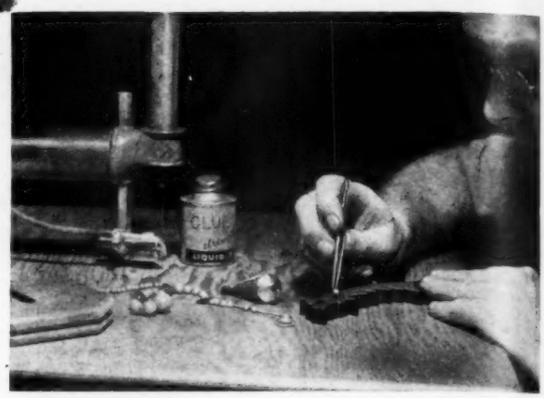
Jig-Sawed Dragon Supports Bracket





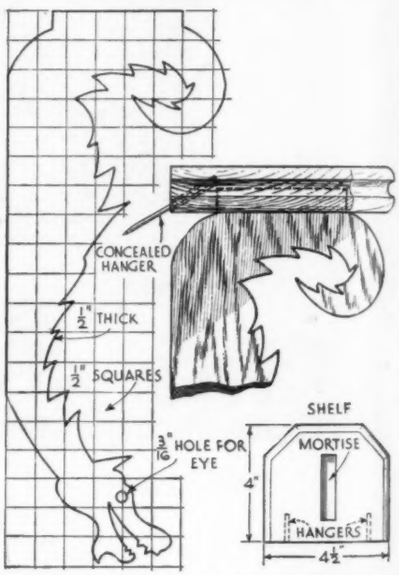
The finished bracket and, above, setting in a bead to form the eye. As a guide for jig-sawing, a full-size paper pattern is fastened to the wood, preferably with rubber cement

FOR a room furnished in Chinese style, I recently made two dragon brackets of teakwood. A merchant who saw them ordered twenty made from mahogany for a special sale, and now wants fifty more for his regular stock.

This particular type of ornament is best made of mahogany unless teak or some other oriental wood is available. Two dragons can be cut without excessive waste from a piece ½ by 6 by 12 in. The shelves are 4 by 4½ in. and at least 1 in. thick.

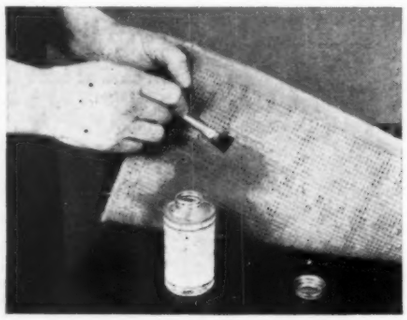
The new "planer" jig-saw blades will produce a smooth, polished edge that requires no sanding. Use a fairly large blade for cutting the outline, and a puzzle blade for the mouth and spines of the tail. Fill the eye hole with a plastic wood composition, and insert blood-red glass beads with the holes turned slightly forward to resemble pupils.

Cut a mortise in the shelf to fit the tenon on the tail, but do not glue the parts until after the finish is applied. A finish that greatly increases the Chinese illusion is obtained by applying red mahogany stain, then rubbing in paste wood filler with the finger tips, and sealing the wood with well-thinned shellac. When dry, rub with fine steel wool and apply wax.



Pattern to be copied on ¼-in. squares; the shelf; and large detail of the invisible hanger

Invisible hangers are made by boring small holes at a steep angle in the shelf and inserting finishing nails, points out. With the nails in place, press the bracket sharply against the wall. The nails will puncture the plaster and remain embedded after the bracket is removed. Drive them in securely and hang the bracket over them.—ALEXANDER MAXWELL.



Applying ordinary rubber cement on the underside of a rug to prevent it from slipping

RUBBER COATING MAKES RUGS SLIP-PROOF

THE slipping of small rugs on polished or waxed floors is a real hazard. One or two applications of a rubber preparation sold especially for this purpose is the best remedy to prevent the rug from sliding. In an emergency, ordinary rubber cement may be used. Applied on the underside, the rubber solution can hardly be seen when dry. Small rugs are often coated only at each corner.—R. W.

BUILD THIS SHORT-WAVE SUPERHETERODYNE

(Continued from page 61)

Complete details for winding the various coils and inductances are given in the box on page 61. Study the schematic wiring diagram carefully before making the prong connections on the 1¼-in. plug-in coil forms. Notice that when a plug-in coil is inserted, windings L_4, or L_3 plus L_4, are connected into the oscillator circuit depending on whether prong 4 or prong 5 is connected internally to prong 6 on the plug-in coil form. As indicated in the coil specifications, prong 5 is connected to prong 6 on coils Nos. 1 and 2 while prong 4 is connected to prong 6 on coils Nos. 3 and 4.

WHEN operating the receiver, the thrills of the police calls and the 160-meter amateur station will be found on plug-in coil No. 4; airport transmitters and eighty-meter amateurs will be received on coil No. 3; fifty-meter airport stations, forty-nine-meter broadcast stations, and forty-meter amateurs will be covered by coil No. 2; while coil No. 1 will bring in the nineteen- to twenty-five-meter broadcast stations as well as the twenty-meter amateur phones. Commercial phone channels will be found through the entire frequency range.

A word about the results obtainable: With the original receiver shown, used by the author, reception after dark has been exceptionally good even on the twenty-five-meter band where DJC (Germany), GSB (England), FYA (France), and 12RO (Italy) are consistent performers. Of course, it may take you a while to learn the knack of tuning, but remember, the set is very selective and careful dialing is as important as a good antenna on the shorter wave lengths.

The parts required in the construction of the receiver are as follows:

C_1 and C_2.—Dual midget variable condenser, 140 mmf.

C_3, C_6, and C_8.—By-pass condenser, tubular, .01 mfd. (400 v.).

C_4.—Fixed condenser, mica, .001 mfd.

C_5.—Sectional by-pass condenser, .1—.1—.1 mfd. (400 v.).

C_7 and C_{10}.—Condenser, mica, .0005 mfd.

C_9.—Dry electrolytic by-pass condenser, 25 mfd. (25 v.).

C_{11}.—Midget variable condenser, 50 mmf.

L_1 and L_2.—Plug-in coils. Six-prong forms. See specifications.

L_3 and L_4.—Oscillator coils. See specifications.

L_5.—Oscillator feed-back coil. Wood form, ½ in. diameter. See specifications.

L_6 and L_7, L_8 and L_9.—Air-tuned intermediate-frequency transformers, 465 kilocycles.

L_{10} and L_{11}—Midget radio-frequency chokes.

L_{12}.—Beat oscillator feed-back coil. See specifications.

L_{13}.—Choke, 85 mh.

R_1.—Fixed resistor, carbon, 20,000 ohms.

R_2.—Fixed resistor, carbon, 1,000 ohms.

R_3.—Fixed resistor, 400 ohms.

R_4.—Potentiometer, 25,000 ohms.

R_5.—Fixed resistor, carbon, 5,000 ohms.

R_6.—Potentiometer, 10,000 ohms.

R_7.—Fixed resistor, carbon, 100,000 ohms.

R_8.—Fixed resistor, carbon, 250,000 ohms.

R_9.—Fixed resistor, carbon, 500 ohms.

Miscellaneous.—Antenna and ground terminals, speaker jack, aluminum chassis, toggle switch (SW), three tube shields, five six-prong sockets, one six-prong isolantite plug-in coil socket, composition tubing (one inch diameter), four six-prong plug-in coil forms, tuning dial, one type '57 tube, two type '58 tubes, two type 2A5 tubes, a power supply (see text), power supply cable, connecting wire, lug, screws, solder, etc.

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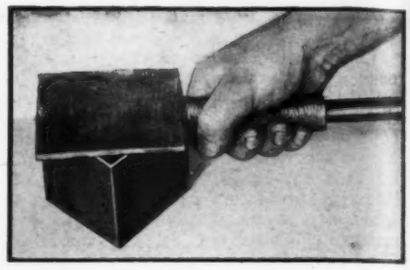
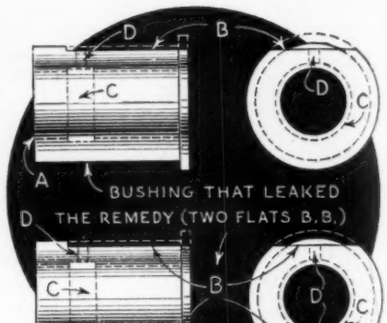
FELT COVER AND GRIP FOR BABBITT LADLE



Babbitt ladle with combination felt handle and cover in position for pouring the metal

TO KEEP Babbitt metal from being chilled on the surface while it is being carried from the fire to the job and also to prevent splashing and provide a cool grip, I recently made a sliding cover of felt for the ladle as shown. The felt is cut about twice as long as necessary to fit over the ladle; then part of it is bent around to form a cylinder and the edges are laced together to slide on the handle. When the Babbitt metal is being heated, the cover is pulled back to the end of the handle.—H. MOORE.

MACHINING A BUSHING TO STOP OIL LEAK



The oil leak was prevented by the simple but ingenious expedient of milling an extra flat

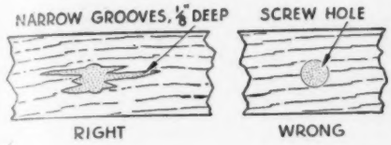
BRONZE bearing bushings of the type illustrated, which were used in an airplane motor, allowed oil to leak badly at the end marked *A*. This was remedied by a simple expedient, which might have other uses.

As originally installed in the motor, the bushing had a flat milled at *B*, an oil groove on the inside at *C*, and oil holes drilled through from the flat to the groove at *D*. All that was necessary to stop the leak was to mill another flat opposite *B*, which allowed the oil to circulate freely and return to the case.—J. ARTHUR BOWERS.

REPAIRING COMMUTATORS

IT IS not always necessary to replace a commutator on a motor or generator that has developed trouble because of broken-down or carbonized mica between the segments. There are various commutator cements on the market, but a cheap and effective repair can be made by using powdered mica and sodium silicate (water glass). Scrape out the carbonized mica until the space between the segments is clean; then fill the space with a mixture of these ingredients, about as thick as putty. Let the patch dry for a couple of hours and smooth it with sandpaper. Repairs of this nature, where not too deep, have lasted for years.—RUSSELL M. REED.

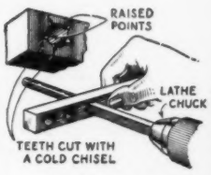
CAMOUFLAGING HOLES IN FURNITURE



Irregular grooves are chiseled in the wood before pressing the composition into the hole

WHEN it is necessary to use wood composition of the plastic type to cover a screw or dowel hole on a piece of furniture that is to be stained and varnished, the sharp, regular outline of the hole is likely to remain conspicuous. This can be avoided by cutting three or four narrow, irregular grooves about ⅛ in. deep each way from the hole, parallel with the grain of the wood, and filling them as well as the hole with the composition. The composition then looks much more like the natural grain of the wood and is inconspicuous.—HAROLD R. SMITH.

WOODEN DOWELS TURNED WITH SIMPLE TOOL

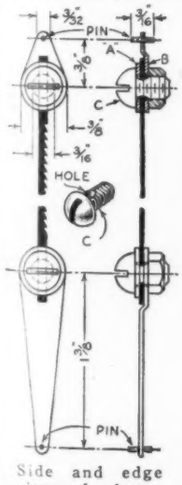


A homemade tool for turning small dowels

DOWELS can be quickly turned from wood with the tool illustrated. It should preferably be made of steel, but iron or even hard brass will do for temporary purposes. The hole in each case should be slightly larger than the bit to be used for boring the dowel holes. After the hole has been drilled in the tool, cut the teeth with a cold chisel and then pass the drill through from the opposite side to remove the bur. If this is not done, the dowel will be too small. A piece of wood of nearly the required size, either square or round, is held in the chuck of the lathe, and while it is in motion, the tool is pressed firmly and steadily on the wood. It is well to make a tool with several holes graduated in size so the dowels can be worked down.—JAMES H. BEEBEE.

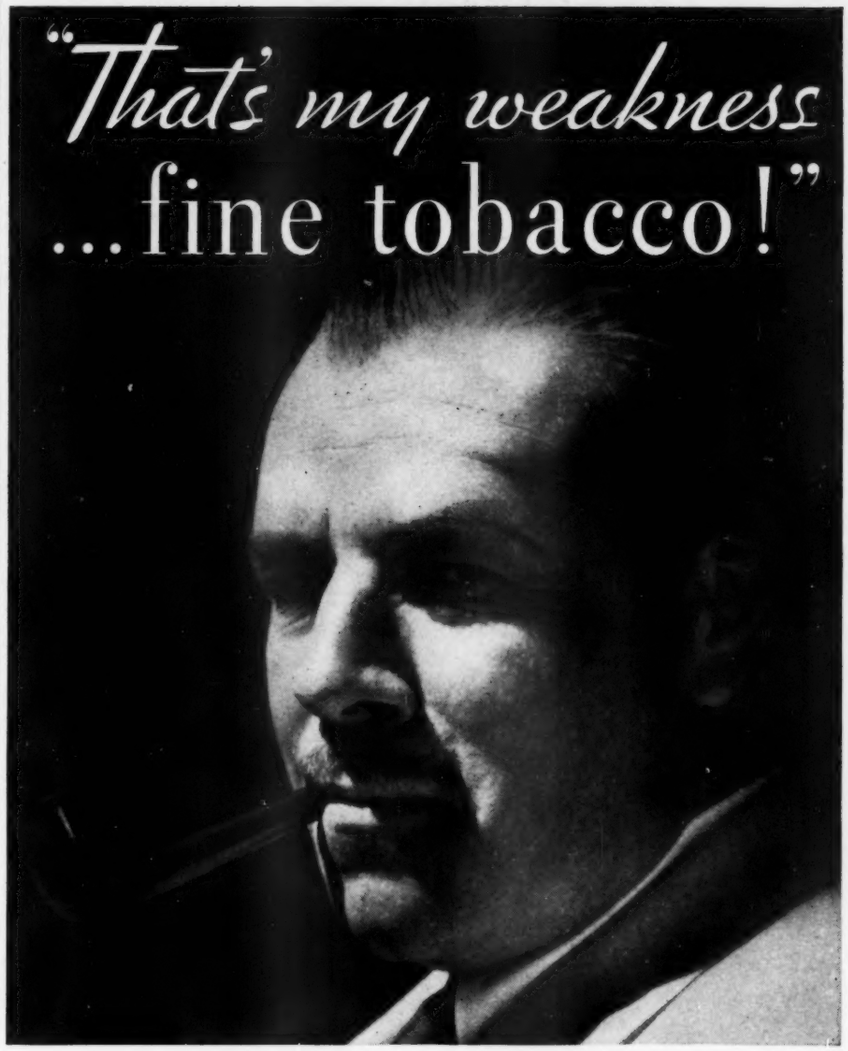
PIN-END ADAPTER FOR JIG-SAW BLADES

THOSE who own power jig saws designed to take only pin-end blades can make simple fret-saw blade adapters as shown. In effect, these convert any standard 5-in. fret-saw or puzzle blade into a 6½-in. pin-end blade.



Side and edge views of adapter

The washer *A* and the pin-end piece *B* are cut from 20-gage sheet brass and drilled as indicated. The pin is a section of a ½-in. brad cut off and riveted lightly to expand it in the hole. If no drill sufficiently small to make this hole is available, one can be improvised by grinding the point of a needle. The ¼ in. long 10-32 machine screw *C* is pierced close to to the head with a 3/32-in. drill. In use, the blade is inserted between the washer and the pin-end piece and through the hole in the screw.—H.L.D.



JACK HOLT . . . noted Columbia Pictures star

YOU'VE read about the hobbies of movie actors. Well, my hobby happens to be fine tobaccos. And I guess I've tried them all, including the most costly of the imported brands. But for steady, day-after-day smoking I've found that the mellow, sun-ripened Kentucky Burley in Union Leader is the most satisfying. It never has the slightest bite, nor ever makes my pipe strong. Yet is as rich in flavor and in fragrance as old wine. (Have you tried Union Leader in cigarettes, Mr. Holt?)

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MAKING LIFELIKE PORTRAITS

(Continued from page 74)

This source of illumination should consist of one or more blue photo bulbs. For softer results this light should be diffused. The highlight lamp is designed to be directed down on the subject at such an angle as to cause high lights on the forehead, nose, lips, and chin, but to leave shadows under the eyebrows and nose.

The effect of both lights is shown in Fig. 4. Notice how clearly the high lights stand out. If in practice the blue of the high lights on the subject should not appear to be of greater intensity to the eye than the yellow of the flat lighting, the flat light is too close and should be moved back.

The third or top light, while not absolutely necessary, helps tremendously in making the subject stand out from the background. A single bulb placed over head and a little to the rear of the subject will do for this purpose.

A spot light is the fourth light source. It is used to throw a brilliant high light along the side of the face or forehead. The spot is also handy in lighting up parts of the portrait which otherwise would photograph too darkly.

The result of all four lights appears in Fig. 1. This illustration is the completed picture and shows what can be expected.

The only legitimate objection to panchromatic film is that the hair, eyes, and dark clothing appear too dark. This difficulty is easily remedied with a camel's-hair brush by applying a water-soluble red dye on those parts of the negative that print too dark. This dye can be bought, and it is possible to apply it to a large portrait negative in five or ten minutes. The procedure is more practical than the old method of using a film that does not emphasize the dark portions of the picture, but which requires hours of tedious retouching—something beyond the scope and patience of the average amateur. Figure 1 shows the picture as retouched, with the darker portions lightened.

IN order to avoid a pasty look on the finished picture, a powdery complexion should not be tolerated and, in case the subject is a woman, only the nose should be powdered, and that very lightly. If the features have a slightly oily sheen, so much the better, as they will then catch the high lights and add to the roundness of the portrait. It is desirable that a woman's lips be shaped with lip stick of fairly dark shade since the film has a tendency to render the natural lips a trifle light. False shadows can be created, when the subject's nose is too wide or bulbous, by putting lip rouge on the sides of the nose, blending in the edges and leaving clear a narrow streak down the center. This make-up gives the effect of a high-bridge nose. The rouge can also be applied to the eyelids to give depth to the eyes, or to any protruding lumps on the face to make them recede.

When using multisource lighting it will be found that the eye may catch more than one high light, which imparts at times a confusing look. It is best to pick out one pair of high lights and etch the others. Care should be taken as to which high lights are retained and which are removed, because the expression of the eyes can be changed by the position of their high lights. For example, when the high lights are directly in the center of the pupil, the eyes will have a piercing look; and when the high lights are moved out of the center of the eyes, the look is softened. The proper placing of the high lights where the eyes are slightly crossed results in great improvement. The light is removed from one eye and another one put in its place by means of a sharp pencil point. The added high light, however, is moved towards the ear, but is kept on the same level as the original. This adjustment has the effect of turning the eye out a little, thereby correcting the defect of crossed eyes to a great extent.

Of course, in common with all film, panchromatic must have the correct exposure and developing time, but the most difficult part—the part that this article is intended to make clear—is light balance. Solve the problem of light balance and the way is clear for better portraiture.

Taking Self-Portraits *with a* Single Light

SUPPOSE you have only one light available and no one to tell you when the light is properly placed or to press the button for you. Set the light above and at an angle of 45 deg. Simply by attaching a small mirror to the camera, you can see when the light is right on your face. Focus by means of a string attached to the lens standard, with a knot you can hold to your face to show the proper distance. Use the lens opened up enough to allow an automatic exposure. If the shutter has a delayed-action release, the rest is easy. If not, set it off with thread.

For self-portraits, attach a mirror to the camera to study the lighting effect

CIGARETTE WRAPPINGS MAKE TOUGH, TRANSPARENT SHIMS

CIGARETTE wrapping of the cellophane type is an ideal material for shims—smooth, transparent, tough, and uniform in thickness. It is so superior to tissue paper that I have long used nothing else. When used for set-up work, it is possible to see the layout lines through the cellophane, and its smooth, glossy surface and toughness enable one to slide it into tight places and pull it into position. Five thicknesses may be obtained in regular cellophane: No. 300, which is approximately .00088 in. thick; No. 450, .0012 in.; No. 600 .0017 in., and No. 1200, .0034 in. Moistureproof cellophane is usually .0010 in. thick. Sheets may be purchased or wrappings saved from cigarettes and various other merchandise. This material is greaseproof and oilproof so that the shims do not become soaked with oil and may be wiped off and used again.—P. A. E.

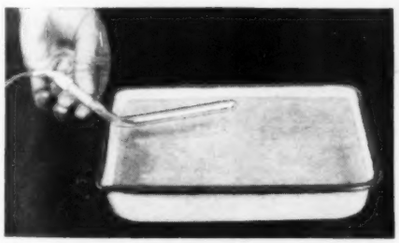
PHOTO MOUNTS RECESSED WITH WARM FLATIRON

The print is sponged with alcohol and water, then pressed into shape over thin cardboard

PLATE-SUNK photograph mounts of professional appearance may be produced by using only an electric iron and a cardboard matrix. A piece of moderately thin cardboard is cut to the size and shape of the area to be sunk. The reverse side of the mounting paper is then sponged with a mixture of equal parts of alcohol and water and pressed into shape on the matrix with the edge of the warm electric iron.—RALPH PAGE.

CURLING-IRON ELEMENT HEATS DEVELOPERS

A SPARE heating element for a curling iron, sold for 25 cents, is useful to warm developing solutions in their trays. The heater should be inserted in a glass tube that is sealed at one end. The tube should then be held in a gas flame to bend it at a spot where the lead-in wires emerge from the insulating cement. The two lead wires are soldered to silk-covered lamp cord. Surgeon's tape wrapped about the open end will exclude dust and protect the wires.—R. W.



Warming a developing solution with an electric heater made from a curling-iron element

SAFETY PINS BENT INTO FILM-HOLDING CLIPS

FILM clips for developing cut films and film packs in tanks can be made quickly and cheaply from safety pins. The point guard is removed from a No. 3 safety pin, and an eye is formed and turned as shown. The point of the pin is bent so that it goes through the eye, and in use, the film is held with the point piercing its edge. The clips are threaded on ⅛-in. rods by slipping the rod through the coil of the pin.—D. R.

Take Snapshots INDOORS!

NOW 25¢ LIST

Such pictures easy with

G-E MAZDA PHOTOFLOOD LAMPS

This marks the genuine

. . . good for dozens of shots

Three years old today . . . and her own birthday cake! What a chance for a picture! Snap it indoors . . . even at night if you wish . . . as easily and as inexpensively as outdoors . . . thanks to super speed film and G-E MAZDA Photoflood lamps.

These amazing lamps are good for two hours of picture-taking . . . good for dozens of indoor snapshots.

All you need is a camera with a fast f/6.3 lens*, super speed film, and a few G-E MAZDA Photoflood lamps in bridge or table lamps. Then you are ready to snap pictures of your family, friends and birthday parties at the click of the shutter . . .

INDOORS AT NIGHT! See your druggist or camera dealer. General Electric Company, Nela Park, Cleveland, Ohio.

** With slow-lens box and inexpensive folding cameras, a time exposure of one or two seconds will get good pictures . . . or use G-E MAZDA Photoflash lamps.*

FOR ACTION PICTURES and shots of babies and pets, use G-E MAZDA Photo*flash* lamps. They operate simply, in light socket or from flashlight batteries. Enable even box cameras to get lively night shots. Each lamp gets one picture. Retails for 15 cents.

GENERAL ELECTRIC MAZDA PHOTO LAMPS

General Electric manufactures lamps for home lighting and decoration, automobiles, flashlights, photography, stores, offices, and factories, street lighting and signs . . . also Sunlight lamps.

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. . . because he made his ideas COUNT!

PERHAPS Jim was no brighter than other young fellows about the office. But he had one good practice. When he had an idea for improving office routine or increasing sales, he typed it out neatly on his Remington Portable and sent it into the head office. Those neat memos of Jim's were read, they attracted the boss's attention. When a vacancy occurred, it was natural to give Jim the promotion.

Every boss is looking for good ideas

Every boss is looking for good ideas. A Remington Portable will help you put your thoughts on paper in clear, easy-to-read style. Maybe your abilities are along selling lines. Perhaps you can write. Perhaps you have a natural aptitude for advertising. Whatever you can do, typewrite your ideas. Executives have no time to struggle with handwriting. Big magazines won't even consider stories and articles that aren't typed. Typewriting has started many a young man and woman on the way to bigger earnings and lasting success.

Amazing

TYPEWRITER BARGAIN

New Remington Portable only 10c a Day!

10 Days Free Trial Offer

Only 10¢ a day buys this latest model machine. Not a used or rebuilt typewriter. Not an incomplete machine. A beautiful brand *new* regulation Remington Portable. Standard 4-row keyboard; standard width carriage; margin release on keyboard; back spacer; automatic ribbon reverse; *every essential feature found in standard typewriters.* Carrying case *free.* Now reduced 25% . . . absolutely the biggest typewriter value ever offered! Try it in your home or office 10 days *free.* If you do not agree that it is the finest portable at any price, return it at our expense. Don't delay. FREE TYPEWRITER COURSE. Mail coupon now.

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Please tell me how I can buy a new Remington Portable typewriter for only 10¢ a day. Also enclose your new catalog.

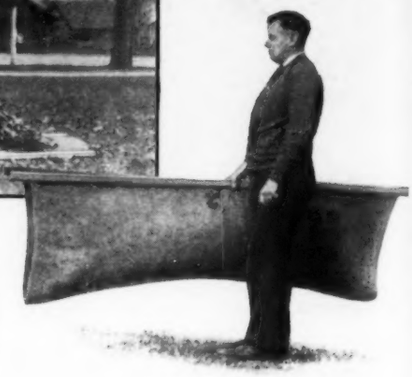
Name _____

Address _____

City _____ *State* _____

BURLAP CARRIER FOR RAKED-UP LEAVES

The holder is stretched flat on the ground while the leaves are raked onto it, and then picked up as shown below for carrying



WITH this carrier, the leaves are raked on a burlap or canvas sheet, two sides of which have been tacked to two long, light strips of wood. A good size is 3 by 7 ft., the sticks being tacked to the 7-ft. sides.—MARJORIE MEYER.

TABLE LAMP BUILT IN FORM OF TREE

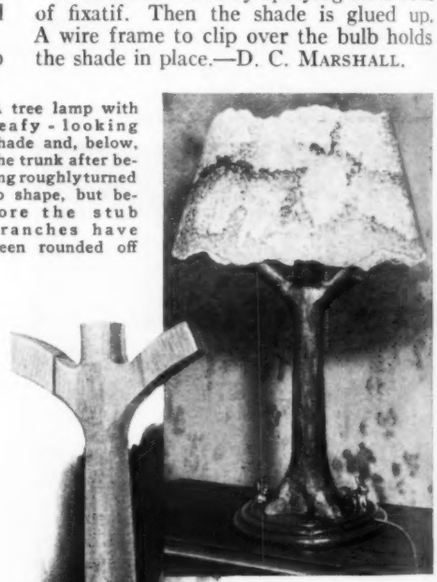
YOU have never seen a lamp as lovely as a tree, but this one comes close to it, with its trunklike support and shade of leafy green. In constructing one like it, the first step is to glue six blocks on a white pine post as shown in the drawings. A hole is bored through the center, and the post is turned to shape.

Round up the stub branches at the top with a rasp and file. The ends may be finished to resemble broken ends or hollow limbs. The base of the trunk is then shaped irregularly to resemble the roots. The roughness of the bark is imitated by rasping irregular grooves in the surface, and the whole is given a coat of brown stain, which is all the finish it will need.

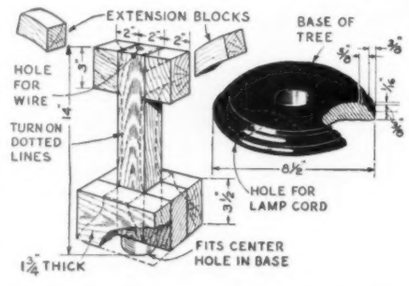
The base of the lamp is turned from walnut and bored as shown with holes to receive the cord and to fit the pin on the lower end of the post. The center part of the base is painted green to represent grass, while the outer edge is given a rubbed varnish finish.

The little squirrel and rabbit, sawed out on a scroll saw, are optional with the builder, but they add a realistic touch. They are fastened on with a pin driven down through the body into the base.

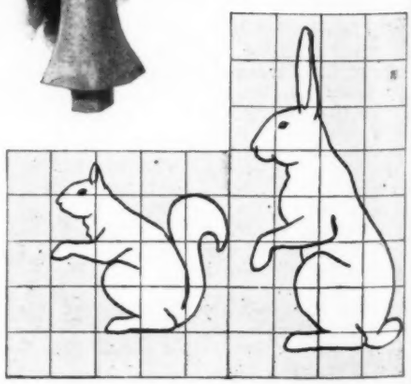
The shade may be made of parchment or oiled poster board. The leaf design is drawn with crayon or colored pencils. It runs through a range of colors from light green on the upper portions to dark blue-green, with black in between. The colors are fixed by spraying on a coat of fixatif. Then the shade is glued up. A wire frame to clip over the bulb holds the shade in place.—D. C. MARSHALL.



A tree lamp with leafy-looking shade and, below, the trunk after being roughly turned to shape, but before the stub branches have been rounded off



How the trunklike column is made by gluing blocks of wood at the top and bottom of a central piece 2 by 2 by 14 in.; a drawing of the base; and, at right, patterns for a squirrel and rabbit for decorating the base



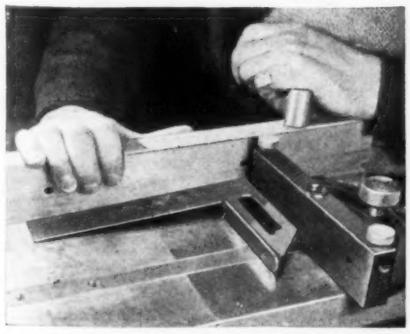
VARIETY OF TOYS MADE FROM COFFEE CANS

A CAN opener and some straps are all that are required to turn empty coffee cans into toys. A drum is made by cutting two slots in the side of a can to take a neck band, as shown. The lid is secured with a drop or two of solder. The clackers or can-walkers are prepared by making two slots diametrically opposed in the bottom of a can to receive the strap for the foot.

The loose or false rims inside the modern type of coffee can are easily removed and make excellent toy embroidery hoops without alteration.—D. A BUTLER.

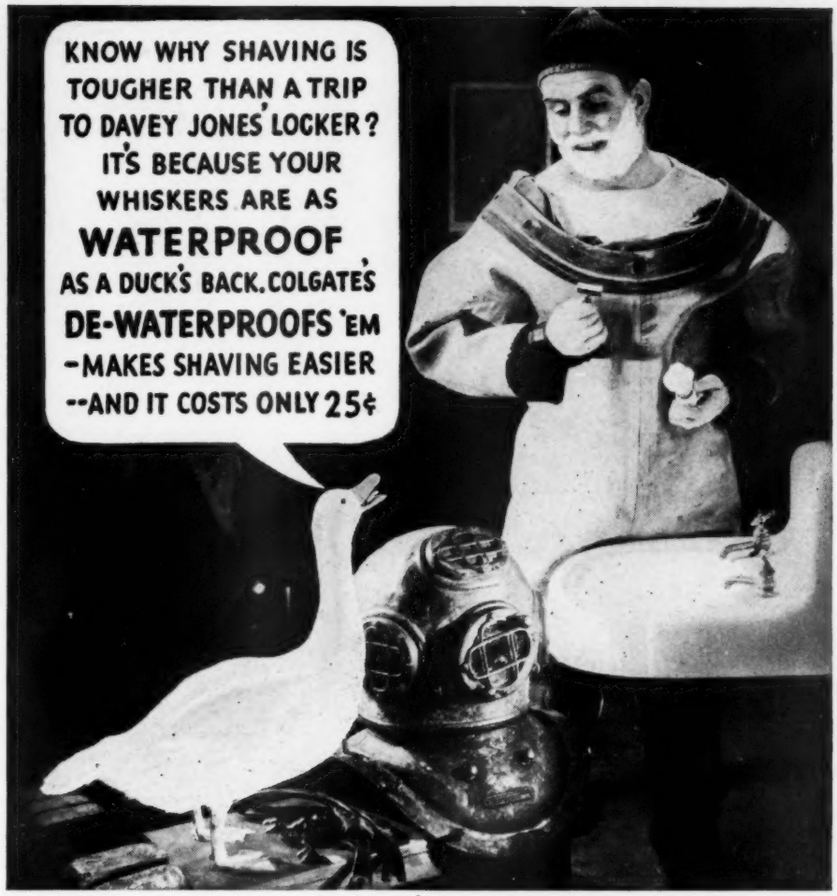
DRY-CLEANING GLOVES

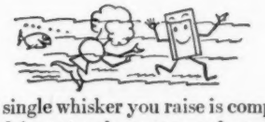
THERE is a simple method of cleaning leather gloves that will not stiffen or otherwise affect the leather. The gloves are painted with either a good rubber cement or scraps of live rubber dissolved in carbon disulphide to make a syrupy solution. When the gloves have dried, which will take several hours, place them on your hands and rub them together. The dry rubber will roll off in small pieces, removing all the dirt.—K. L. R.



SQUARING A RIP GAGE

THE rip gage of a circular saw is usually lined up by several measurements taken from the blade while it is in different positions. An easier and very accurate method is to see first that the miter gage is square with the gage slots in the table and then use a square to set the gage as shown above.—E. A. BOWER.


KNOW WHY SHAVING IS TOUGHER THAN A TRIP TO DAVEY JONES' LOCKER? IT'S BECAUSE YOUR WHISKERS ARE AS WATERPROOF AS A DUCK'S BACK. COLGATE'S DE-WATERPROOFS 'EM -MAKES SHAVING EASIER --AND IT COSTS ONLY 25¢



Every single whisker you raise is completely encased in a tough, waterproof coating of oil. And that oily coating makes whiskers wiry—and shaving hard.

However, there's a way to soften up your whiskers so they'll cut easily. Just strip off every trace of that waterproofing from *every* whisker.

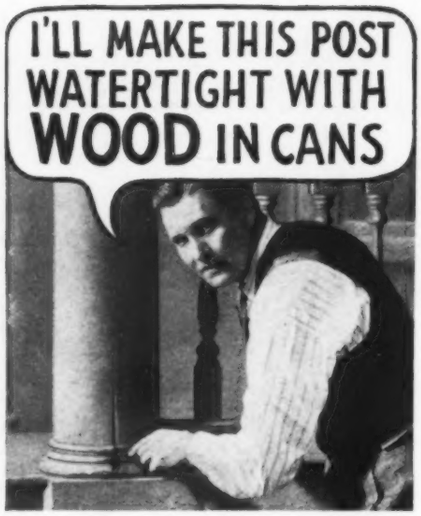
But—it can't be done with most shaving creams. For most shaving creams make a frothy, *big-bubble* lather—and those *big* bubbles *can't* get down close to *every* whisker.

To completely de-waterproof your whiskers, use Colgate's. For Colgate's Shave Cream whips up into millions of tiny, *little* bubbles —so small that thousands of them crowd *close* to each individual whisker.

As these tiny bubbles swarm around each whisker, they remove every trace of that oily, waterproof coating. They *emulsify* it, *dissolve* it—wash every bit of it away.

Then—myriads of these tiny bubbles soak every whisker soft. Result—your razor can cut through each whisker smoothly, easily, without scrape or pull. Try Colgate's—and discover easier shaving. Discover, too, how much better it makes your face feel. The large 35¢ tube is now only 25¢.

P. S.—Wind up your Colgate shave with Colgate's After-Shave and Colgate's Talc for Men . . . and enjoy a smooth, cool face.



Dries to Hard, Permanent Wood Handles Like Putty - Water-proof Weather-proof - 1001 Uses

Prevent deterioration and decay—check those vital spots—porch pillars, leaky window-sills, under window-sills, door frames, cracks in stucco, cement, bricks—use *Plastic Wood* and be assured of a permanent repair—will withstand the ravages of bad weather.

Plastic Wood offers the means of saving many dollars where repairs are needed—this marvelous discovery—a wood in putty form hardens into lasting wood—can be sawed, planed; holds nails and screws firmly without splitting or crumbling; can be sanded, painted or varnished, will adhere permanently to any clean and dry surface—wood, metal, stone, tile and glass.

The uses of Plastic Wood are limited only by the imagination—is stronger than real wood, has all the properties of wood, except grain—is water - proof, weather - proof and grease-proof.

Never be without Plastic Wood. Get a 25c tube or 35c can in any paint, hardware, or department store. Comes in nine different colors.

Other Uses

Repairing broken furniture
Evening-up chairs, table legs
Filling gaps along baseboards
Resetting loose casters
Resetting loose drawer pulls
Drainboard cracks
Cracks in shelving
And 1001 Other Uses

NRA

PLASTIC WOOD

DURABLE Tile-Top Tables

BUILT WITH EITHER WOOD OR METAL FRAMES

By Herman Hjorth

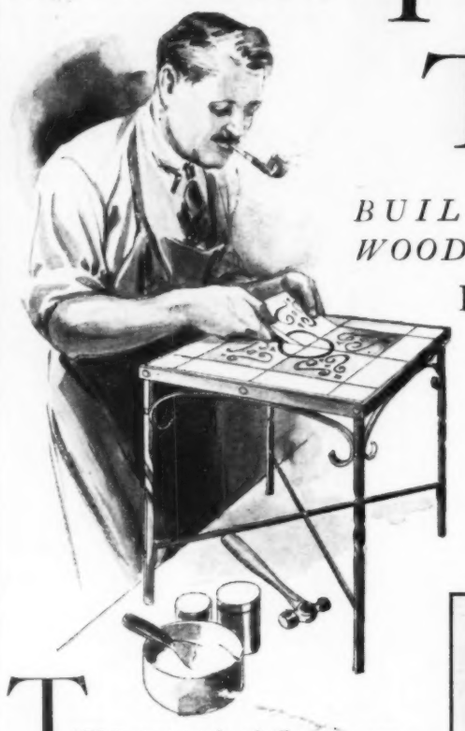


TABLE tops made of tiles may serve various purposes, but they are especially useful for coffee tables or smoking stands because they are neither damaged by hot or cold liquids and alcohol nor burned by cigars or cigarettes.

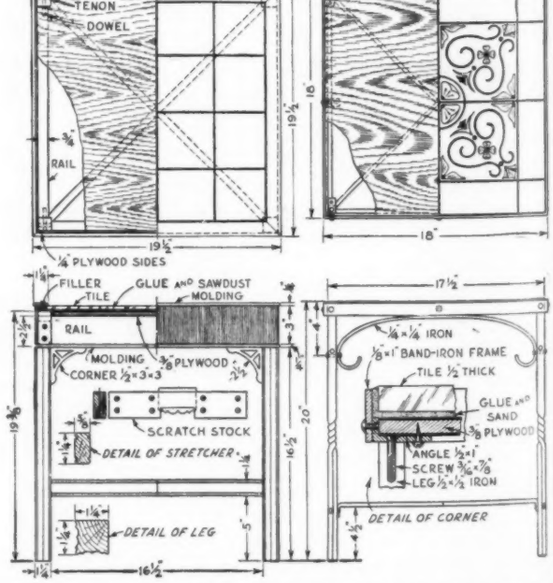
Before beginning the construction of such a table, it is important to select the tiles. Bathroom tiles, obtainable everywhere, are the least expensive, but they are not as decorative as hand-made tiles, which come in an endless variety of patterns.

Having selected your tiles, build the table according to the dimensions of the tiled top. The top of the wooden table illustrated was made of sixteen pale blue bathroom tiles, each 4¼ in. square and ¼ in. thick. A checkerboard pattern can be obtained by using tiles of different colors or by using two shades of the same color.

The wooden table is designed in the Chippendale style. The legs and rails are first sawed and planed to dimensions. The two outside surfaces of each leg may be shaped with a scratch stock—a cutter made from a thin piece of steel clamped between two pieces of wood. A piece ¼ in. thick and 2⅞ in. long is cut from the two outside surfaces on the upper end of each leg to make room for the ¼-in. plywood sides. Two of the rails are joined to the legs with a through mortise-and-tenon joint, and the other two with dowels passing through the tenons. The stretchers are joined to the legs with dowels.

The base for the tiles is made from a piece of ⅜-in. plywood, fitted around the legs and planed flush with the outside surfaces of the rails. It should be glued or screwed to the upper edge of the rails. The tile are fastened to the base with casein glue, to which sand or sawdust is added to make it thick enough. A layer of this paste, about 3/16 in. thick, is spread over the base, and the tiles are pushed into it until they are flush with the filler strips, which should be nailed in place beforehand. If necessary, the joints may be pointed afterwards with the same mixture. After this is dry, the molding and plywood

Wooden table designed in Chippendale style with tile top and, above, table made of iron



Working drawings of both the wooden and iron tables. Slight changes have been made in the wooden table, and stretchers added

sides are mitered and glued in place. The plywood sides should be cut so that the grain runs up and down as shown. The corners are made from ½-in. stock and glued in place.

Any table may be fitted with a tile top simply by cutting a hole of the desired dimensions in the old top and screwing a piece of ⅜-in. plywood to its underside. Some blocking may be necessary in order to bring the tiles flush with the top.

The woodwork may now be stained, shellacked, and finished in the usual manner.

An iron frame may also be made for a tile top. The one shown in the drawing does not require any welding or heating. The top may be made from sixteen bathroom tiles 4¼ in. square, or from four hand made tiles 6 in. square and ½ in. thick surrounded by a border of tiles or glass of a contrasting color—for example, black.

List of Materials

WOODEN TABLE

No. of Pieces	Description	T.	W.	L.
4	Legs	1¼	1¼	19⅜
2	Rails	¾	2½	19
2	Rails	¾	2½	16½
2	Stretchers	⅝	1¼	24
4	Filler strips	⅜	½	18½
4	Moldings	¼	½	19½
4	Moldings	¼	1¼	19½
4	Plywood sides	¼	3	19
1	Plywood base	⅜	18½	18½
8	Corners	½	3	3

IRON TABLE

4	Legs	½	½	19
1	Frame	⅛	1	74
8	Angle irons	⅛	½	1½
4	Braces	¼	¼	24
2	Diagonal braces	¼	¼	26
1	Plywood base	⅜	17¾	17¾

NOTE: Dimensions are given in inches and are, as far as practical, the finished sizes.

The frame is made of a piece of band iron ⅛ in. thick and 1 in. wide. This should be hammer marked with a ball-peen hammer and straightened, after which the corners are bent at right angles in a machinist's vise. It is riveted together in one corner with ⅛-in. rivets.

The four legs are made from ½-in. square iron and given a twist in the middle, so that the lower part is at 45 deg. to the upper part. This is done by clamping one end of the leg in the vise at the beginning of the twist and using a monkey wrench to turn the bar until the desired shape is obtained. If bent out of shape, the iron can be straightened with a hammer. Protect the twisted portions, however, with blocks of wood. With exception of the twisted parts, the legs should be hammer marked. The legs are fastened with machine screws passing through angle irons riveted to each corner of the frame (see detail).

The construction is further strengthened by diagonal braces riveted to the lower part of the legs, and four bent ¼ by ¼ in. pieces riveted to the legs and frame. These braces must be hammer marked before being bent.

The finished framework should be cleaned with steel wool, wiped off with benzine or turpentine, and given a thin coat of flat black paint or lacquer. When dry, this is rubbed with No. ½ emery cloth until the bright color of the iron shines through the black paint. Some parts are rubbed more than others. The table is now wiped off and either waxed or given a coat of clear lacquer.

The base for the tiles is made from a ⅜-in. plywood panel, which is fastened with screws to the eight angle irons. The tiles are glued to this base as previously explained.

New 6-INCH JOINTER by "Delta"

SPECIAL FEATURES of new Delta 6-in. Jointer

1. New Patented Delta fence with 3 Automatic Stop Positions;
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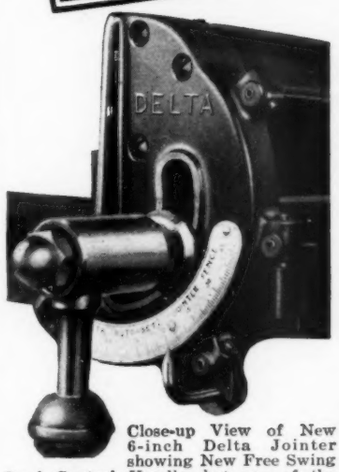
3. New Free Swing Dual Control Handle;
4. Cuts up to ½-inch deep rabbet;
5. Long Hollow-cast Tables;
6. Special Dove-Tailed Ways on which Tables ride.

And many other unusual features and improvements.



Close-up View of New 6-inch Delta Jointer showing New Free Swing Dual Control Handle—but one of the many special features of this unusual Tool. Note 3 Automatic Stops for setting fence quickly in most-used positions.

NEW TOOLS
New Improvements in 1935 Delta line

The new 6-inch Delta Jointer is but one of the many new improvements and tools announced this year by Delta engineers. This year the Delta line of motor-driven woodworking tools is more complete than ever before. Delta standards of efficiency, quality, and convenience have been strictly maintained—and Delta prices still kept at their low levels. Good compact motor-driven tools are within the reach of all. Every woodworker will find the new 1935 Delta line of unusual interest.

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Within a short time, the 1935 catalog of Delta quality tools will be off the press. It is crowded with photographs and information about the new line of 1935 Delta tools. It shows how Delta tools are built to stand the grind of production work, and yet are so low priced as to be within the reach of all.

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32 page book "Practical Delta Projects"—crowded with new and "out of the ordinary" things to make—with over 100 photographs, working drawings, and easy-to-understand illustrations. Simple, complete instructions make every project easy to follow. Every woodworker should have this book. Send only 10 cents with coupon. Book and 1935 Delta catalog, will be mailed postpaid.

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I enclose 10c (stamps or coin), for which please send me one copy of "Practical Delta Projects". Also place me on your mailing list to receive 1935 Delta catalog of quality motor-driven woodworking tools.

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NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

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Shelves and Lamp, Modernistic, *93*	.25
Stand, Low Modernistic, *100*	.25
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Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage Audio-Frequency, *42*	.25
Five-Tube Short Wave (A.C. or D.C.) *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 8}

Aircraft Carrier—U. S. S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in), *226-227-R*	.75
Bark, Scenic, Half-Model (13½-in.), *108*	.25
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper Ship (20¼-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Indianapolis* (12 in. long), *216*	.25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Galleon, Spanish Treasure (24-in.), *46-47*	.50
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in. balsa wood model made very simply in layers), *225*	.25
Liner—*Manhattan* (12 in. long), *204*	.25
Liner—*St. Louis* (11-in.) *231*	.25
Pirate Galley or Felucca (20-in.), *44-45-R*	.75
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230*	.75
Roman Galley (19-in.), *138-139-R*	.75
Sails—Square and Fore-and-Aft for Whaler *Wanderer* or any Model, *185-186*	.50
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Schooner—*Bluenose* (17½-in.), *110-111-112-R*	1.00
Stagecoach (20¾-in.), *115-116-117-R*	1.00
Stagecoach with horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Viking Ship (20½-in.), *61-62-R*	.75
Weather Vane, Ship Model (30-in.), *66*	.25
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht—A simplified water-line model of cup defender (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

MISCELLANEOUS

Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Log Cabin (three rooms), *134-R*	.50
Microscope Kit, Portable, *220*	.25
Perpetual Star Chart, *214*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

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Send me the blueprint, or blueprints, numbered as follows:

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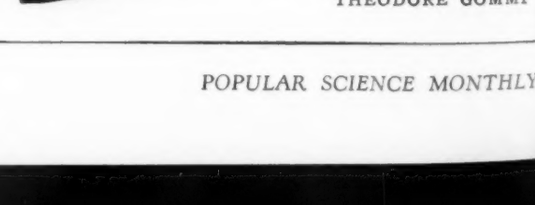
WHICH is the simplest of your ship models for a beginner?" is the question often asked us. It is our 9-in. waterline model of the liner *Aquitania*. This is made by cutting out layers of thin wood to match the full-size patterns on the blueprint, and gluing them together—the easiest and most foolproof method imaginable. The drawings really serve as patterns, and no skill is required to read them. Blueprint and complete instructions, price 25 cents. Order No. 225.



S.S. *AQUITANIA*
MODEL BY
THEODORE GOMMI

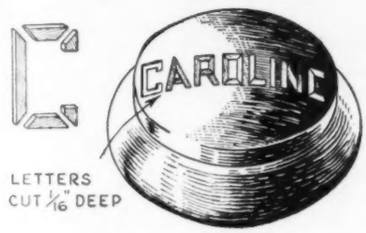
HOW TO INLAY NAMES IN WOODEN NOVELTIES

Small turned wooden box with name inlaid in the cover to make it a more personal gift

HOMEMADE powder and jewelry boxes form more attractive and personal gifts if they are inlaid with the name of the person for whom they are intended.

Lay out the name with a sharp pencil, then cut to the outline with a jackknife about 1/16 in. deep. Inlay with any wood that will show up plainly. Miter all joints wherever possible. After the inlay has been glued in and has dried, sandpaper it flush.

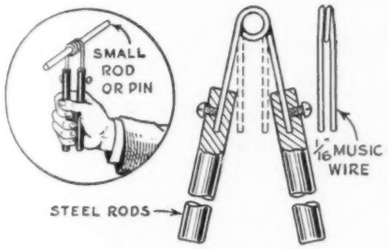
For powder box and jewelry box designs, see P.S.M., Apr. '29, p. 80; Jan. '30, p. 105, and Mar. '31, p. 94.—ROBERT PUTZER.



Square-cornered letters are used so that the inlaid strips may be cut with mitered joints

QUICK-ACTING PIN VISE FOR PRODUCTION WORK

WHEN a large number of small pins must be held for filing or grinding, much time is wasted in opening and closing the conventional type of pin vise. The vise illustrated is more rapid and powerful.



The pin is slipped through the coil of the spring and gripped by squeezing the handles

Two steel rods about 3/8 in. in diameter are drilled to take a piece of 1/16 in. music wire, which is held in position by the screws shown. The wire is then coiled about one and a half times around a round rod, slightly smaller in diameter than the pins to be gripped.—L. KASPER.

TUBE FOR TELESCOPE

AN EXCELLENT body tube for a homemade telescope can be obtained from newsprint paper cores. These can usually be obtained from large newspaper plants for little or nothing. The walls of the tube are about 1/2 in. thick, which makes them very strong. They can be made waterproof by wrapping them on the outside with a layer of linen tape, and then giving them two or three coats of paint, inside and out.—C. G. G.

You may differ with the traffic officer about the speed you were going . . . but you're both likely to agree that MODEL is the best tobacco you ever bought for 10 cents. In pouch packages for men who like to dip in to fill their pipes, or in tins for men who like to carry tobacco that way. MODEL has everything—for 10 cents!

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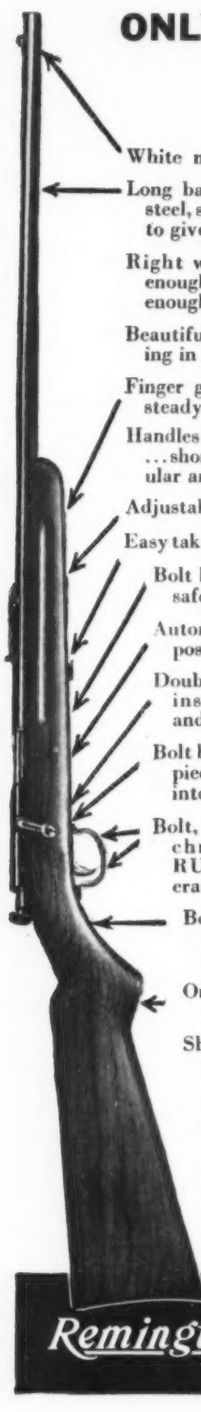
for the Boy!

COMPARE the outstanding features of this Remington Bolt Action Rifle, Model 33, with any other .22 rifle on the market today. Then if you agree with the hosts of present owners that it's the greatest gun value ever offered, it's yours for

ONLY $5.50



White metal bead front sight.

Long barrel, 24 inches, selected steel, specially bored and rifled to give extreme accuracy.

Right weight—4½ lbs. Light enough to carry all day; heavy enough to hold steady.

Beautifully balanced for shooting in any position.

Finger grooves allow firm grip, steady, accurate aim.

Handles all types of rim fire .22's ...shorts, longs, long rifle; regular and Hi-Speed.

Adjustable rear sight.

Easy take down...no tools needed.

Bolt head shrouded for extra safety.

Automatic ejector — strong, positive!

Double locking lugs on bolt insure greatest accuracy and safety.

Bolt handle and lugs one solid piece, permanently locked into bolt.

Bolt, bolt handle and trigger chromium plated. NO RUSTING! Smooth operation.

Bolt safety permits removing cartridge from chamber while safety is on.

One-piece American walnut stock and fore-end.

Shotgun type steel butt plate.

See this wonderful rifle at your dealer's and be all set for Xmas—or write today for descriptive folder. Remington Arms Co., Inc., 1733 Seaview Avenue, Bridgeport, Conn.

Remington DU PONT

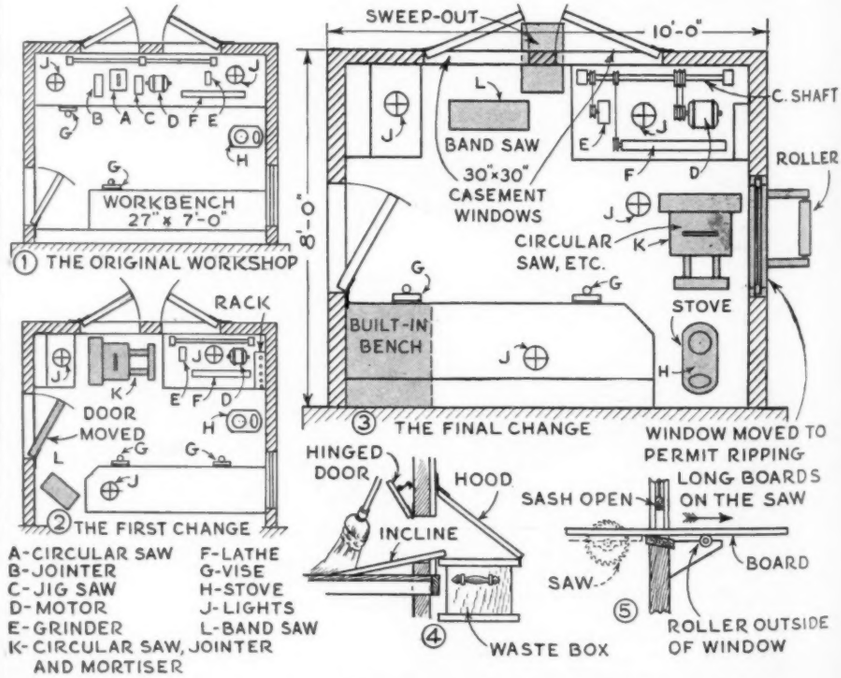
How the shop was rearranged to make room for new and larger machines. The band saw, however, was in such an awkward place that the plan had to be changed again as in Fig. 3 below

PITFALLS TO AVOID IN

Laying Out a Shop

HERE is a home workshop especially built for the purpose, adjoining the garage. It is a step in advance of the plans given in the two preceding articles of this series (P. S. M., Aug. '34, p. 83, and Sept., p. 74). The builder of the shop expected it would fill his needs completely, but through subsequent experience he discovered several disadvantages. These will be pointed out here, as well as the manner in which they were eliminated, so that other readers may profit by this man's experience.

In Fig. 1 is shown the original floor plan. The equipment consisted entirely of a home workshop outfit having a single



Three plans showing the gradual evolution of a small motorized shop. Foresight would have saved much work. Sketches 4 and 5 show a waste box and a roller extension for the saw table

LAY OUT YOUR HOME WORKSHOP

(Continued from page 90)

motor which drove, through a countershaft, a small lathe, circular saw, scroll saw, jointer, and grinder. For this layout the shop was adequate, but with the acquisition of a large combination circular saw, jointer, and mortiser and also a band saw, it was necessary to cut away the two benches as shown in Fig. 2. The shaded machines represent the new equipment. The door also had to be moved to the center.

In this arrangement the band saw was found to be in an awkward position for large work, and it often had to be pulled out upon the floor. Furthermore, it was not possible to plane or rip boards longer than 7 ft. on the combination machine. Further changes were therefore made as in Fig. 3. One end of one bench was replaced and the other removed to make room for the stove. The window was moved to the center, and the circular-saw combination was placed in front of it. Now boards of any length can be ripped by passing them through the door and window. A roller support for this purpose has been built outside the window, as shown in Fig. 5.

A convenient sweep-out chute, with the waste box outside and protected from the rain, is illustrated in Fig. 4.

No better object lesson than this particular shop could be found to drive home the importance of planning.—HI SIBLEY.

Another article on planning motorized shops will be published in an early issue.

CHROMIUM plate on forming dies lengthens their life materially. A thin coating of about .0002 in. is usually found most satisfactory.

. . .

Dry ice, as frozen carbon dioxide is commercially known, can be used to shrink bushings before pressing them into other machine parts.

. . .

The application of a relatively light penetrating oil will prolong the life of wire rope.

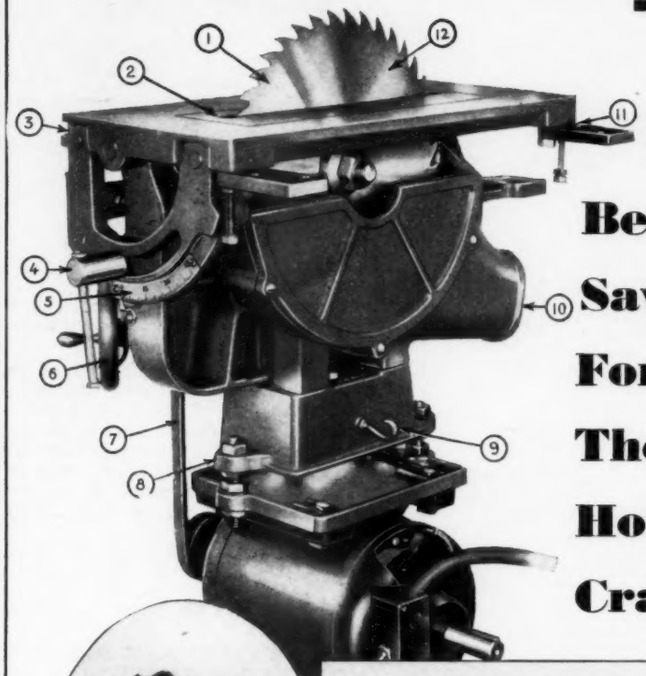
. . .

When your oilstones become worn to an irregular surface, they can be lapped on a bench block.

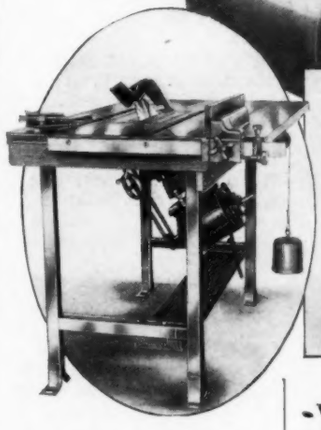
. . .

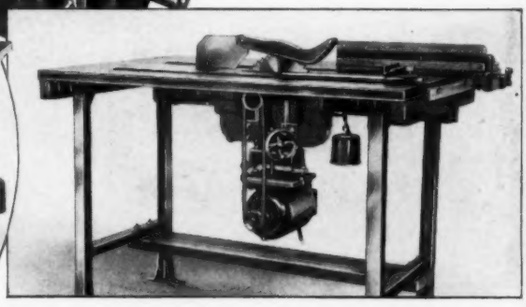
A drop of oil will save many a center drill.

SOMETHING NEW



In Bench Saws For The Home Craftsman





RETRACTABLE TILTING ARBOR SAW

Specifications

1. Cuts full 3" stock.
2. Removable insert for grooving.
3. Saw unit hinges on top plate.
4. Slide bar bolt locks unit at any angle.
5. Indicator shows position of tilting arbor.
6. Saw blade and motor raised or lowered as a unit by handwheel.
7. Heavy duty V belt.
8. Belt adjustment.
9. Hook for counterweight.
10. Outlet for sawdust.
11. Adjustable stop screw for levelling top plate with table top.
12. Highest quality 10" saw blade. (SKF Ball Bearings)

●

Write for free circular showing three lines with all new models. Address Dept. TA.

With this ingenious DRIVER saw unit, table capacity for sawing is limited only by the size of the bench top in which the unit is installed. By simply cutting a hole in the bench top and lowering this unit into position, flush with the top, an outfit of extra convenience and utility is obtained. For angle sawing the entire unit tilts, being hinged on the top plate. When not in use the saw blade may be lowered below the surface of the table leaving the table top cleared for general bench work. The retractable tilting arbor saw unit, bench top, bench legs and motor are available separately or as a complete set. The customary, reasonable DRIVER prices apply. This new DRIVER unit is representative of the new features embodied in the three DRIVER Lines for 1935. A new lathe with gap bed, two new band saws, two new bench saws and a new spindle shaper (all equipped with SKF ball bearings) are among the new models. See your local DRIVER dealer for full information, or write for circular.

WALKER-TURNER CO. INC.

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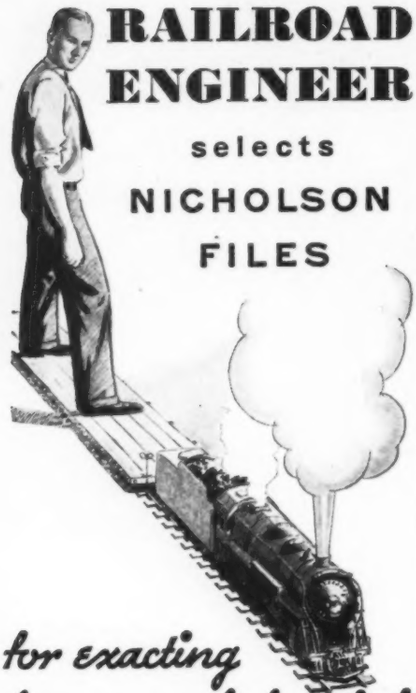
DRIVER POWER TOOLS

RAILROAD ENGINEER

selects

NICHOLSON

FILES



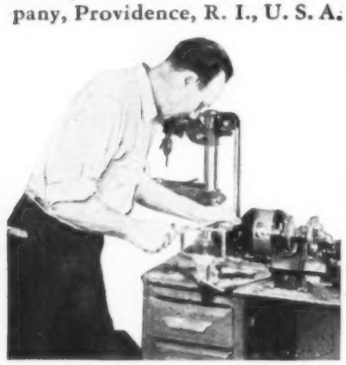
for exacting home workshop job

Mr. E. W. Leaver, twenty-nine years engineer on a leading Eastern railway system, spends his spare time building models of the locomotives he operates. The Pacific locomotive model, shown above, will have a steam pressure of 75 lbs. to the square inch, fire with coal, and pull an estimated weight of 275 lbs.

Mr. Leaver is shown using a Nicholson File to file the foundation ring for the boiler.

●

"For quality and durability I recommend Nicholson Files to every home craftsman in metal and wood," says Mr. Leaver. "I couldn't get along without Nicholson Files, and as for economy, they have given me the greatest value I have ever received for the money." Nicholson File Company, Providence, R. I., U. S. A.



AT HARDWARE STORES EVERYWHERE

NICHOLSON USA

Genuine

NICHOLSON FILES

A FILE FOR EVERY PURPOSE

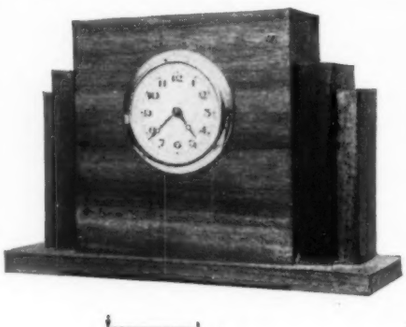
CLOCK CASES MADE FROM WASTE WOOD

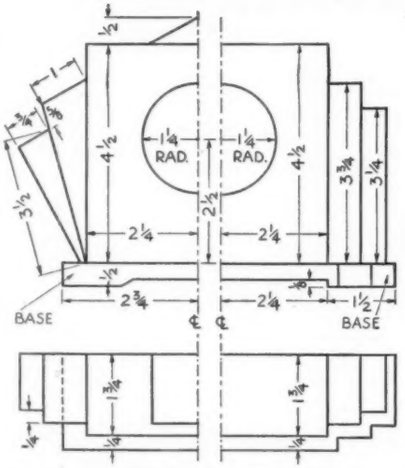
An expensive looking clock case constructed from blocks of wood too good to throw away

WHATEVER work one is engaged on, numerous short ends and awkwardly shaped pieces of wood inevitably accumulate. Some of these can be used in making clock cases of the type illustrated. They are built up in sections, and for those shown no piece larger than 4½ in. square is required. Many pleasing effects can be obtained by combining a variety of woods.

These cases are designed to take a 2¼ in. diameter drum clock, but they can be adapted to take larger or smaller clocks without altering the design or method of construction.

The main body of the case is 1¾ in. thick and can be made, if necessary, of two or more pieces of wood glued together. The hole for the clock should preferably be turned on a lathe. If a lathe is not available, a series of holes can be bored with a brace and bit and then the main hole finished off with a gouge and a half-round file or rasp. The center of this hole should be about ¼ in. above the center of the block.





Another attractive clock case, and working drawings of one half of each of the designs

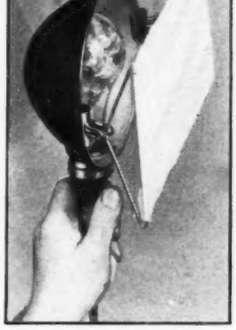
Next prepare the sidepieces. Where the sides of these slope, it is best to bevel off the top ends only, then glue and clamp the blocks in place, and later on plane down the long sloping sides to the required angle.

In a case where part of the first sidepiece is covered by a second piece, the first may be further strengthened by means of brads or screws before the second piece is glued. The base will need only to be screwed on.

Before the clock movements are finally fastened in place, the cases should be carefully cleaned up with very fine sandpaper and given whatever type of finish is preferred.—RAYMOND S. FORBES.

SOFTENING LIGHT FROM PHOTOGRAPHIC BULBS

A SCREEN for softening the light from photoflash and photoflood bulbs can be made in a few moments from two small spring paper clips of the type shown, two lengths of stiff copper or galvanized iron wire, and a small piece of gauze or thin cloth. This screen has the advantage of being instantly applied or removed, and it may be made to fit any commercial or home-made reflector.



Diffusing screen used with photoflash lamp

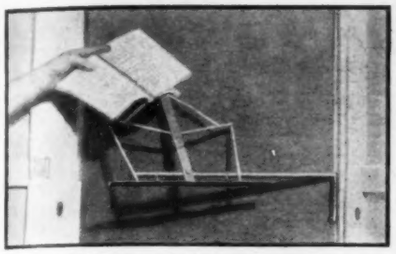
Each wire should be bent to form a triangle as shown, and the joint at the end securely soldered to the inside of one of the handles of a clip. When the brackets have been completed, they should be snapped on the edges of the reflector with which they are to be used and the gauze stretched between them. The cloth may be fastened by overlapping the ends and taking a few stitches.

Of course, the use of any sort of diffusing screen in front of either a photoflood or photoflash bulb results in cutting down the effective light. This means that you must increase the exposur- to compensate for the loss caused by the diffusing screen. If thin, loosely woven cambric is used, increase the exposure two or three times. With photoflood bulbs, this is accomplished by leaving the shutter open two or three times as long. With photoflash bulbs, open the shutter to the next larger setting.—K. M. S.

GLAZIERS' POINTS HOLD PICTURES IN FRAMES

PICTURES are usually set in frames with a backing of cardboard, which is held in place with brads driven into the molding. It is easier to hold the backing with ordinary triangular glaziers' points. Use a pair o wide-mouth pliers and gently squeeze the points into the molding, taking care to protect the wood where it comes in contact with the pliers with a bit of cotton or cloth. With this method there is no opportunity for the glass to become broken or for the frame to be jarred apart. However, there is perhaps some danger of the points' working out in time, but this can be prevented by dabbing glue over the outer edge of each point and the adjacent cardboard.—K. M.

STAND HOLDS COOKBOOK OPEN AT EYE LEVEL



This cookbook stand, designed to prevent eye strain, folds against wall when not in use

COOKING is made easier when a woman can refer to her recipes at eye level instead of having to lay the cookbook on a dish-cluttered table. This home-made cookbook stand is constructed mainly from polished 5/8-in. brass tubing and the top part of a discarded music stand. A 24-in. arm of tubing is cut diagonally at one end and soldered to a 3-in. vertical piece, which nests into a 3½-in. length of ¾-in. tubing. A small metal collar, driven up to within 1 in. of the diagonal joint, supports the arm and allows it to swing in any position. The top of the music stand is held to the arm as shown with a 1¼-in. stove bolt and wing nut. Two clips of bent wire are soldered to the bottom to prevent the pages from turning. The stand should be placed in such a position that it may be folded back against the wall when not in use.—R. H. SPRUNGMAN.

RUBBER STRIPS LESSEN MODEL RAILWAY NOISE

YOUR model railroad can easily be mounted on rubber to cut down the noise. Discarded automobile inner tubes are used. Slit them lengthwise and place the flat strips of rubber thus obtained under the track. An imitation of track ballast can be produced by coating the upper surface with rubber cement and sprinkling with fine bluestone chips. Another method is to cement felt or wool on the rubber before laying it. The fabric can be dyed any color desired.—H. H. AYRES.

PUTTY MIXED AS NEEDED TO PREVENT WASTE

PUTTY is frequently needed in the home workshop and for odd jobs about the house, but much is wasted because it gets so hard. The best and cheapest method is to mix it only as needed. Get some Spanish whiting and boiled linseed oil from the paint store, and when putty is needed, just mix a little of each to a very stiff consistency. This is a good all-around putty, but other ingredients may be added for special purposes. White lead increases the hardness of the set, but makes the putty very hard to remove. Stains may be added to match woodwork. A few drops of Japan drier added to putty will somewhat reduce the time required for it to set.—M. D. WEEKS, JR.

Learn to Mount Birds and Animals—Send Coupon for Free Book

HERE, TED, YOU SAID YOU WANTED THIS PEST OF A HAWK IF I GOT HIM—BUT WHY DO YOU WANT IT?
THANKS, BOB—WAIT AND SEE.
LATER
WELL THERE'S YOUR HAWK, BOB. HOW DO YOU LIKE IT?
WONDERFUL, TED! BUT WHERE DID YOU EVER LEARN TAXIDERMY?
I LEARNED RIGHT HERE AT HOME IN MY SPARE TIME FROM THE N.W. SCHOOL OF TAXIDERMY—THESE ARE ALL MY OWN HUNTING TROPHIES I'VE MOUNTED MYSELF.
—AND THE SCHOOL TAUGHT ME TO TAN ALL KINDS OF SKINS—IN FACT, I TANNED AND MADE THIS CALF-SKIN VEST MYSELF—AND NOW I GET REAL VALUE OUT OF OUR HIDES BY TANNING THEM INTO GENUINE LEATHER FOR HARNESS, STRAPS, ETC.
SAY!—IF I COULD MAKE REAL LEATHER I KNOW WHERE I COULD GET A DOZEN ORDERS TODAY!
COMMON SPECIMENS—EVEN FROGS, CAN BE MOUNTED INTO DANDY NOVELTIES FOR THE DEN.
TAXIDERMY HAS DOUBLED MY FUN FROM HUNTING—AND PAID ME REAL PROFITS, TOO. SOME MONTHS I'VE MADE AS HIGH AS $80 MOUNTING TROPHIES FOR HUNTERS JUST IN MY SPARE TIME.
SAY, BOB; I'M GOING TO LEARN TAXIDERMY, TOO. GIVE ME THE SCHOOL'S ADDRESS—I'LL WRITE TODAY.

Amazing Pleasure and Profits in This Art

YOU LEARN IT EASILY, QUICKLY, BY MAIL IN SPARE TIME

Men, boys, women,—Study Taxidermy. Taught by Experts. ALL SECRETS revealed. It will amaze and delight you.

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Save your game trophies. They are **Valuable.** Mount them for home and den. Have a **Museum.** Win fame as a Taxidermist. Make undreamed-of money in spare time . . . You learn to mount (stuff) *expertly*, **Birds, Animals, Fish, Game-Heads,** just like life. **That is Taxidermy. You** can be a Taxidermist. Will you? Surely you are interested. Mail **Coupon** right now for the astonishing **Free Book.**

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This old reliable school in 30 years has graduated 200,000 students; all in Taxidermy **Only.** Ask our 200,000 graduates! They **Know** we can teach you successfully. Our great success permits this **Guarantee.** Grasp this **Opportunity**—send coupon right now, **TODAY,** for the **Free Book.**

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Or a postcard will do. No obligation on your part. The beautiful **Book,** with hundreds of entrancing **Pictures** is **Free.** Do not miss this wonderful **opportunity** to obtain the marvelous and valuable book, FREE and POST-PAID. Write today. State your **Age.**

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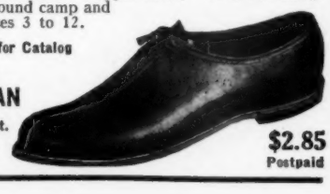

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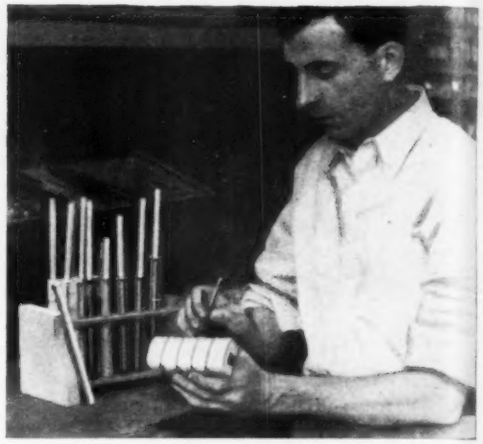
MODEL MAKER'S PAINTS KEEP LIKE NEW IN TEST TUBES



Long-handled corks are fitted in the test tubes so they can be pushed down as the paint is used up

EVEN when they buy colors in small cans, model makers and other craftworkers find much paint is spoiled between jobs through thickening. The writer avoids this trouble by providing test-tube containers in which the corks can be pushed down to the surface of the paint, thus eliminating any air space.

A convenient way to provide such equipment is to build up sets of eighteen test tubes each. The drawing details a rack for holding tubes ¾ in. in diameter and 6 in. deep. The upper shelf is bored with ⅞-in holes, while the lower has corresponding depressions made with a countersink.

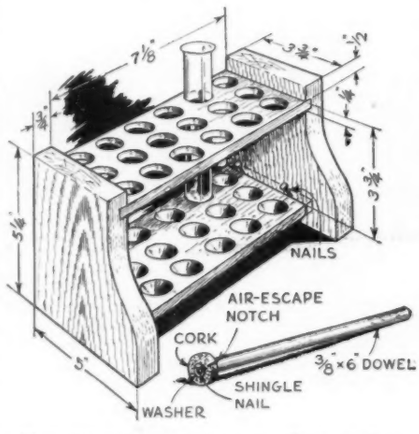
Fit the tubes with corks made by cutting ¼-in. lengths from ordinary bottle corks. Nail the corks to the ends of 6-in. pieces of ⅜-in. dowel sticks. Use metal or fiber washers under the heads of the nails. Sandpaper the edges of the corks so that, when lubricated with paint, they will slide inside the test tubes with sufficient binding to seal the sides. Make a very shallow groove to vent the air.

When putting the tubes into service, fill them about three quarters full of paint from a freshly opened can, or from a used can after the paint has been strained through a clean, lintless cloth. Moisten the cork with the same paint and push it down to the surface of the liquid. The imprisoned air will work through the goove, and the drying paint will seal this slight opening.

Group the tubes according to color. If mixtures are made, save the residue. When several racks of tubes have been accumulated, assemble colors and their tints together, for convenience in locating them. After using the rack, store it on a closed shelf or in a deep drawer, away from dust.

Buying small cans of paint is expensive. By the use of racks of tubes, either pint or quart size cans may be bought without fear of waste, and at a relatively great saving in cost. When a new can is opened, pour it into small bottles or 3-oz. mayonaise jars and seal them. Then use these smaller containers to replenish test tubes.

It will be found that the contents of a ¼-pt. can of paint can be kept in four or five of the tubes.—EDWIN M. LOVE.



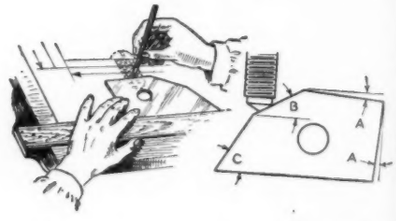
How the paint rack is made. Four or five test tubes hold the contents of a ¼-pt. can

MUCILAGE BOTTLE HOLDS SOLDERING FLUX

FOR holding soldering flux, I use a mucilage bottle of the type illustrated. The rubber spreader is convenient for applying the flux to the metal and makes a brush unnecessary; furthermore, it is not affected by the zinc chloride solution. Since the spreader remains sealed except when in use, there is no danger of spilling the flux. From every standpoint, in fact, the bottle is a more satisfactory container than a small glass jar of the type ordinarily used, because the latter has a metal cover that corrodes readily and is difficult to keep tightly in place.—HARRY EVERETT.

The rubber tip of the bottle is useful for spreading the flux and prevents spilling the solution accidentally

THREAD TEMPLATE SAVES DRAFTSMAN'S TIME



THIS template for draftsmen will be found useful when drawing threads and various other details. The template may be made from any suitable material, preferably transparent. It can be quite small, although the size is immaterial. Angle *A* is approximately 4 deg.; angle *B*, 30 deg.; and angle *C*, 60 deg. The hole in the center of the template is for hanging it up when not in use.—HARRY KAUFFMAN.

WRITING HOME MOVIE TITLES ON FILM STORAGE CANS

IT IS difficult to write film titles on the humidor cans in which amateur motion picture film is kept. This problem may be overcome, however, if the space in which the title is to be written is thinly coated with film cement. Then, after writing the title in ink, another coat of film cement is applied so the letters will not rub off.—HERBERT SCHEINBERG.

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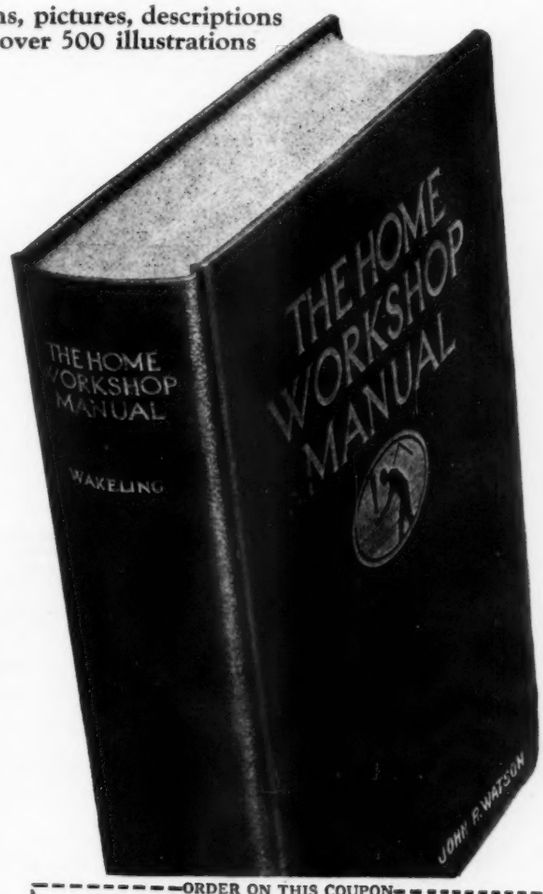

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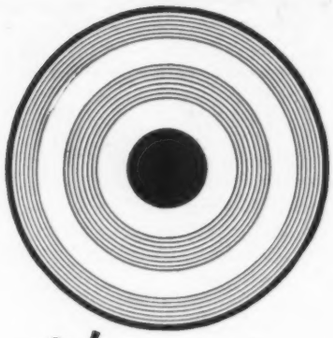

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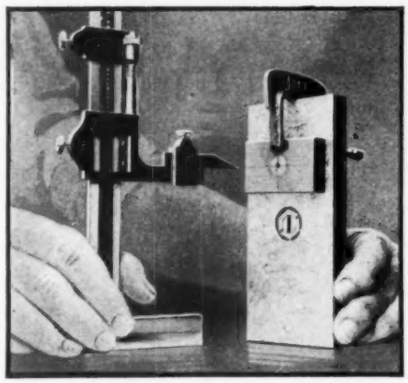
TAKE-DOWN ANGLE PLATE FITS IN TOOL CHEST

FOR light work this angle plate serves all practical purposes, and it can be taken apart and stowed away in the tool chest. For laying out and checking work on a surface plate, it is superior to the ordinary heavy cast-iron plate because it presents a minimum of surface under which dirt and



This unusually convenient little angle plate is supported behind by means of a try-square

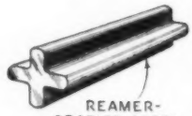
minute pieces of steel can collect and scratch the surface plate. It is also easier and quicker to make than a cast-iron plate as no pattern is necessary.

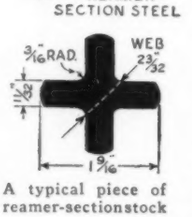
The angle plate is composed of a rectangular piece of cold-rolled flat steel and a superannuated hardened try-square. If a better construction is desired, the plate may be made of tool steel, hardened and ground, but holes should be tapped in it before it has been hardened for strapping work on, if desired. The square is held to the back of the plate by a slotted bridle. This is drawn tight on the blade of the square by a nut set flush into face of plate. A slotted stud at bottom prevents square from turning when set.—G. J. MURDOCK.

How the square is attached to the plate

SPECIAL REAMER STOCK REDUCES TOOL COST

THESE are times when machine shops, whether operating independently or as a maintenance department, are increasingly concerned in cutting costs. It is not sound policy, however, to change the size of a good tool simply to avoid making a new one, especially in the case of odd-size reamers, counterbores, bottom-squaring tools, countersinks, and the like. The cost of making these can be reduced through using high-speed reamer-section steel. This is available up to 2 9/16 in. in diameter and should be ordered 1/16 in. oversize. The slow milling operation is entirely eliminated, but the tools are, of course, hardened and ground in the usual manner. As an example of the saving, reamer-section steel of the size shown weighs 4.2 lb. per foot as compared with 7.2 lb. for round stock.—R.J.M.





A typical piece of reamer-section stock

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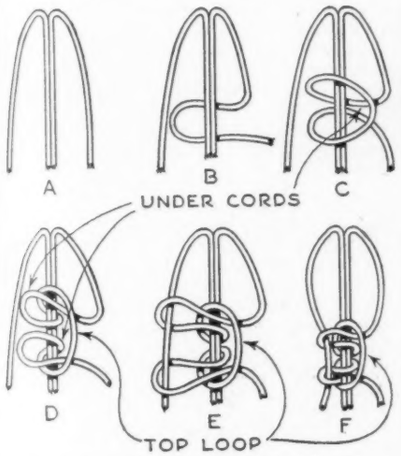
A QUICK WAY TO TIE SQUARE KNOTS

WHEN doing decorative square-knot work, there is a way to tie the knots that is quicker than any method I have seen illustrated. Make your cords fast and attach the center two to whatever style of holder you use, as shown at *A*. Take the right-hand cord and double it under the center cords as



A method of tying square knots that saves time in making belts and similar fancywork

at *B*. Then bring it over the top as at *C*. The next step *D* is to draw the undercords through the top loop to form a double loop, through which you pass the left-hand cord as at *E*. Then, holding the right cord in the right hand, grasp the top loop with the left hand (the loop at the right in sketch *E*) and take out the slack as at *F*. To finish, draw both sections up tight.—CLARENCE J. HARTZ.

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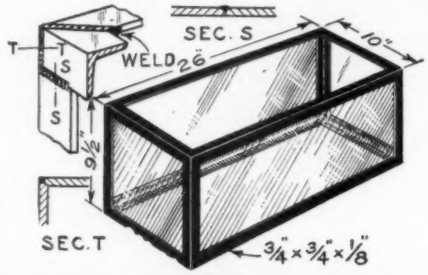
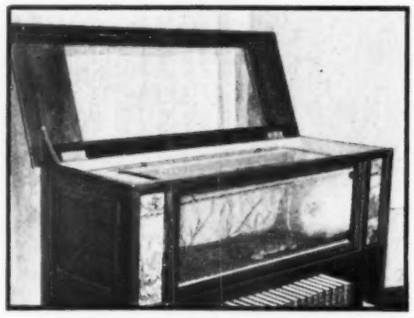
ILLUMINATED AQUARIUM IN BOOKCASE

(Continued from page 71)

ful use of a sharp chisel and fine sandpaper. Do all the final finishing work possible, such as scraping and sanding, on the case before the moldings are applied. Fit base *14*, which is mitered at the corners, and assemble with glue and screws. Molding *8* should be fitted very snugly and may be simply glued and clamped in place, as shown in one of the photographs. Add the molding at the base and the panel molding, if used; these can be secured with glue and countersunk brads. Fit the lid hinges and the sliding lid support to



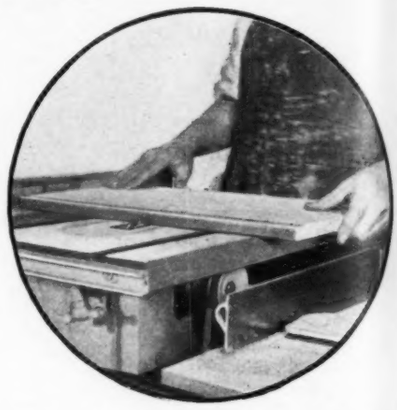


A suggestion for making a tank and how it appears in the case with the lid turned up

hold it open. Fit back panel *15*, slide it into place from the bottom, and secure it with a few screws into the shelves and partitions.

The interior of the top compartment housing the aquarium may now be painted or lacquered a light gray or cream color. The outside may be stained and finished as desired, although a two-coat spar-varnish finish is recommended.

The end panels are of ground glass with the decorations painted on the rough side. Small pieces of the size required, 2 15/16 by 9 5/16 in., are really scrap sizes, and may often be obtained for little or nothing. Obtain some extra pieces to practice on. Lay out the design carefully full size by the square method or by pantagraph; or better yet, by having a photostatic or photographic enlargement made of the magazine drawings. Lay the glass over the enlargement, ground side up, and lay in the black lines with a rather thick paint made by mixing lampblack ground in oil with a little spar varnish. A very fine camel's-hair striping brush is satisfactory for laying in the broad sweeping lines. The smaller details are put in with an ordinary writing pen. You may find it easier, in fact, to do all of the lining in with the pen.

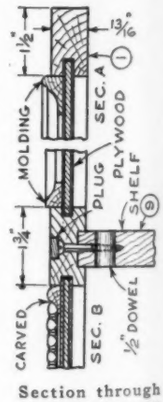


While a dado head facilitates the work, the grooves can be made with successive saw cuts

Allow the black lines to dry twenty-four hours or more before doing the tinting. The colors used, in addition to black, are cobalt blue, chrome green, burnt sienna, yellow, and red. The best way to obtain them is in small tubes ground in oil. Mix with spar varnish and thin with turpentine. Use a medium sized camel's-hair artist's brush for applying them to the glass.

Do not have the colors too thick, as they must show up by transmitted light. The effect should be observed from time to time as the coloring is being done by holding the glass up before an electric light. If too much color is put on, it may be removed by brushing gently with a brush dipped in clear turpentine and soaking up with a clean cotton rag. The finished glass panels are held in place by lengths of molding *7*, screwed in place from the rear.

A metal pan made of thin aluminum, zinc, or copper should be put under the aquarium to safeguard against small leaks that might develop. After the aquarium-bookcase is in its final location, the tank may be put in place and filled. The wiring and switch is then installed and the porcelain socket receptacles screwed down in such positions that the lights illuminate both the fish and the glass panels to the best advantage. A 15-watt bulb at each end was found adequate for illumination. If heat as well is desired, as in the case of tropical fish, it may be necessary to use larger bulbs. Then it would be advisable to install a sheet of pressed prism glass behind the glass panels in order to control and distribute the illumination over the whole picture.



Section through the upper part of a side panel

List of Materials

Part No.	Name	No. Req.	Description
1	End panel	2	13/16 x 12½ x 32 11/16 over all
2	Lid	1	13/16 x 13½ x 35¼ over all
3	Top rear rail	1	13/16 x 1¾ x 33⅜
4	Top front rail	1	13/16 x 13/16 x 33⅜
5	Post	2	13/16 x 13/16 x 9¾
6	Lid glass molding	4	2—25 in., 2—10 in.
7	Painted panel molding	12	4—3¼ in., 4—9¾ in., 4—9⅜ in.
8	Aquarium molding	4	2—9¾ in., 2—26 in.
9	Upper shelf	1	13/16 x 12 x 33
10	Middle shelf	1	13/16 x 12 x 25⅜
11	Lower shelf	1	12 x 33 in. long
12	Partition	2	13/16 x 12 x 20¼
13	Base molding	3	2—14 in., 1—36 in.
14	Base	3	13/16 x 2½, 1—36 in., 2—14 in.
15	Back	1	¼-in. fir 3-ply, 33⅛ by 21½
16	Aquarium frame	1	10 x 9½ x 26 in. over all, made of ¾ by ⅛ in. steel angles
17	Tray	1	10½ x 27 x ⅝ in. deep
18	Ground-glass panels	2	2 15/16 by 9 5/16
19	Butt hinges	1 pr.	1½ x 2
20	Sliding lid support	1 pr.	

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Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

HOW TO GIVE TURNINGS A "FRENCH POLISH"

OLD as the so-called "French polishing" process is, many of those who have recently taken up wood turning have never learned this effective method of finishing woodwork.

The materials necessary are: orange shellac for dark woods, white shellac for light woods, denatured alcohol, an oil can containing ordinary light machine oil, a wad of cotton, and a piece of cloth free from lint.

After turning the work, sand it until perfectly smooth with a very fine grade of sandpaper. Care should be taken to avoid scratches. Remove the work from the lathe, wipe carefully to remove dust, and apply a thorough brush coat of shellac. Let it dry for a few

As if by magic, a satinlike polish appears on the turned work

minutes. This can be accelerated by placing the work back in the lathe and letting it turn for a minute or two.

Next place a wad of cotton about the size of a door knob in the cloth, fold up the corners and edges, and tie with a piece of string. Dip this buffer into the alcohol, squeeze lightly, and shake once or twice to remove the surplus. With the brush, apply a little shellac on the working side of the buffer, and add a drop or two of machine oil.

Start the work turning on the slow-speed pulley. Hold the buffer underneath the work and move it slowly from one end to the other, exerting a slight pressure with the hand. As the applying of this polish correctly requires considerable skill and experience, it is well to do a little practicing on unimportant work until the knack has been mastered.

As the buffer dries out, resaturate it with more alcohol and add a few drops of shellac, but use the machine oil very sparingly. The more coats of shellac are applied with the buffer, the higher the polish. If the shellac gums up on the work, stop the lathe and smooth out the finish by using the buffer with a circular motion. Then proceed as before. Do not allow the work to rotate too fast. As if by magic, the surface will assume a satinlike appearance such as can hardly be duplicated by any other method of wood finishing. The surface becomes as hard as glass and resembles the finest of hand-rubbed piano finishes.—L. H. YOUNG.

SILENCING A NOISY ELECTRIC CLOCK

A SMALL electric clock suddenly developed a noise that sounded as if the motor were running away with itself and knocking at every revolution. I took the clock out of its case and used a small pair of tweezers to bend the spring that holds the flywheel snugly up against the shoulder on the shaft. This was to give more friction. Then I cleaned off all the grease on the face of the flywheel where the spring presses. After replacing the case, the clock ran silently.—C. G. GROVER.

SOMETHING "CONCEALED" IN THIS PIPE TOBACCO

Providence (R. I.) Pipe Smoker Says the "Something" Is Missing in All the Other Brands He Tries

A flavor—a taste—is difficult to describe in words. However, the experienced pipe smoker knows when he finds the right tobacco.

July 20, 1933
United Electric Railways Co.
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Larus & Brother Co.
Richmond, Virginia

Gentlemen:

I have smoked Edgeworth for years. I have tried other tobaccos, as everybody does once in a while, but I have always gone back to Edgeworth. Every once in a while someone comes into my office with some new fangled thing which smells very good. I immediately shift to that. This lasts about a week or so, when there is just something missing, and that something you have concealed in Edgeworth, which compels a return to the old brand.

Yours very truly,
Alonzo R. Williams
1st Vice Pres. & Gen'l Mgr.

What is the "something" which Mr. Williams says is concealed in Edgeworth—the something which compels him to come back to Edgeworth every time he tries some other kind of tobacco in his pipe?

The only explanation the makers of Edgeworth can offer is the fact that in Edgeworth the attempt is to produce the finest, most satisfactory pipe tobacco that fifty years of experience can devise. Edgeworth is made exclusively for the pipe. All the full, rich, delightful flavor of the tobacco is retained. Edgeworth is truly mild. It is guaranteed not to bite the tongue.

You can try Edgeworth in your pipe for a few cents

You can smoke it all day and enjoy every pipeful. If anything is "concealed" in Edgeworth, it is the knowledge of how to combine genuine tobacco flavor with real mildness, and thus produce a pipe tobacco which gives real satisfaction without the least discomfort.

Edgeworth is sold everywhere in convenient sizes, from the 15¢ pocket tin to several sizes in vacuum packed packages. In these vacuum tins, the flavor remains the same in any climate. Please ask your dealer.

Edgeworth is manufactured and guaranteed by Larus & Brother Co., Tobacconists since 1877, Richmond, Va.

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JOIN THE HOMEWORKSHOP GUILD

(Continued from page 68)

problems with them, of learning how to use and look after many kinds of tools and machines, of listening to addresses by experts in various branches of handicraft, and of sharing in all the benefits that come through coöperative efforts. Before the Guild was organized there were no constructive programs and facilities of this type available for amateur craftsmen.

Finally, each club gets certain tangible benefits which are outlined from time to time in the monthly bulletins of the Guild. To give only one example, a free subscription to POPULAR SCIENCE MONTHLY, official magazine of the Guild, is provided for the secretary of each club, to be kept in the club library. Other home workshop literature is made available by the Guild so that in a surprisingly short time any club can build up an invaluable reference library at very little cost. Some clubs have already had to construct large bookcases and filing cabinets to hold their growing libraries of reference material.

To obtain a more detailed list of the advantages of belonging to a home workshop club and for full instructions in regard to organizing one, fill out the coupon at the end of this article and send it, with a large self-addressed and stamped envelope, to the National Homeworkshop Guild in care of this magazine.

LeVern T. Ryder, president of the Guild, has a special message for clubs which do not yet number twenty members.

"I wish to urge these clubs," he writes, "to make a determined drive for new members at once. Meetings are much more interesting if there are at least twenty members, and much more can be accomplished in the way of club and community activities. Another important incentive for clubs to pass this goal is the fact that POPULAR SCIENCE MONTHLY has offered to donate a beautiful silver medal to each club which has more than twenty members so that the club can award the medal as a special craftwork prize at its next exhibition. Application blanks for these medals have already been sent to club secretaries. Every club should take advantage of this opportunity."

The design for the POPULAR SCIENCE medal, which bears the seal of the National Homeworkshop Guild, was published in a previous issue (P. S. M., Aug. '34, p. 75).

The rules and regulations for the first national Guild contest are being prepared by the contest committee and will be mailed to the clubs when ready. Meanwhile the clubs can start to work on suitable projects under the various classifications listed last month and given in one of the recent Guild bulletins.

ADVISORY COUNCIL

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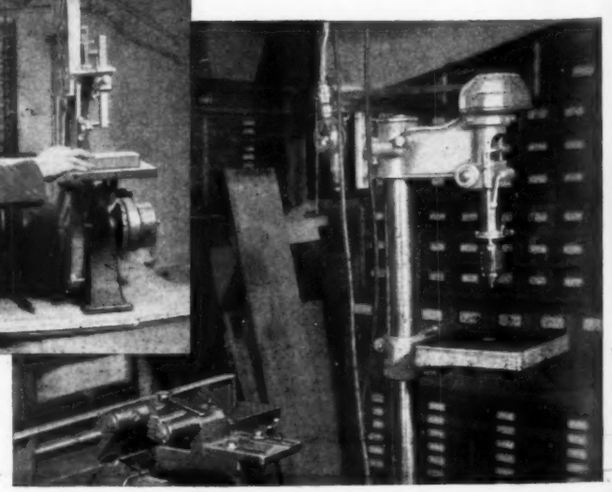
NEWS OF THE LOCAL CLUBS

The Bison Homeworkshop Guild of Buffalo, N. Y., has taken a large booth at a hobby fair to be held by the Buffalo Council of Social Agencies from Nov. 12 to 17 in the Elmwood Music Hall. Each member of the club will be allowed to exhibit one article of craftwork. So that there will be something active going on in the booth at all times, various members of the club will be assigned to demonstrate different types of handicraft. The club will select its own judges for the occasion and award prizes for the best work exhibited. There are already over thirty different crafts represented in the club, and it is expected that a large increase in membership will result from the participation of the club in the hobby fair.

A lecture is shortly to be given before the club by Professor Harmon of the science staff of Lafayette High School, Buffalo, on the pouring at Corning, N. Y. of the 200-in. lens for the telescope being built for the California Institute of Technology. The entire operation will be *(Continued on page 101)*



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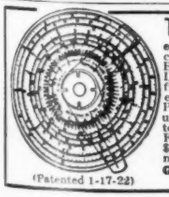

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(Patented 1-17-22) Gilson Slide Rule Co., Stuart, Fla. *Slide Rule Makers since 1915*

HOMEWORKSHOP GUILD

(Continued from page 100)

illustrated graphically by motion pictures.

At one recent meeting several of the more experienced craftsmen in the club were each allotted 15 minutes in which to outline or demonstrate his particular hobby. At another meeting J. B. F. Champlin, president of a large cutlery company, gave a lecture and demonstration on wood carving and exhibited some unusually fine carvings.

John Kintner, secretary of the Pocono's Homeworkshop Club of Stroudsburg, Pa., one of the newer clubs, reports that since the organization of the club with twelve members, new men have come in at every meeting. Raymond Snyder is president of the club. Among its members are two manual training teachers and one expert on tooled leather.

A new club has just been organized at Mount Vernon, N. Y., and has applied for a charter, but a permanent name has not yet been selected.

Full information about the Guild will be sent to any reader who fills out the following coupon.

Where Workshop Clubs Are Established

Akron, Ohio
Amarillo, Texas
Antioch, Calif.
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Austin, Texas
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Lansdale, Pa.
Lexington, Ky.
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Madison, Wisc.
Marshalltown, Iowa
Maywood, N. J.
McKeesport, Pa.
Menomonie, Wisc.
Miles City, Mont.
Mobile, Ala.
Morristown, N. J.
Mount Vernon, N. Y.
New Britain, Conn.
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Norwood, Ohio
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Patillas, Porto Rico
Peekskill, N. Y.
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Provo, Utah
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Scranton, Pa.
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Silverton, Colo.
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Snoqualmie, Wash.
Spokane, Wash.
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St. Charles, Ill.
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Topeka, Kans.
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Warren, Ohio
Washington, D. C.
Wethersfield, Conn.
Wichita Falls, Texas
Wood-Ridge, N. J.
Yakima, Wash.
Yreka, Calif.
Zanesville, Ohio

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am enclosing.

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Address.....

City.....State.....

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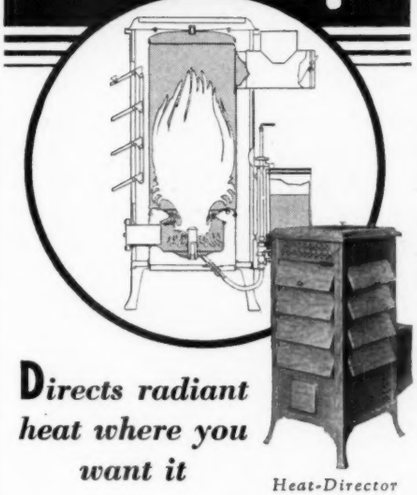

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A RAKISH PRIVATEER OF 1812

(Continued from page 67)

midship line and cut the other to meet the first, and repeated the process. If you have difficulty here, make a knee like that shown on the deck plan only much heavier, and another similar one to fit onto it, and put one inside and one outside the bulwark and clamp them together until the glue is set and you have a few nails in. Then remove these and put in the permanent knee. For this you can cut a fork from a tree twig or pick out wood grain running around a knot. I found such a place on a piece of holly from which I cut all my knees.

THE hole for the bowsprit is next cut, and the bulwarks are shaved down to stand ⅜ in. high, vertically, all along. The gun ports are also cut, all vertical.

The counter at the stern is quite tricky to make. It is easier to cut and file it from the solid, rather than to bend it. A piece 3/16 in. thick is required. It projects its thickness (3/32 in.) onto the hull and fits inside the bulwarks; the lower and upper edges are curved to the camber of the deck, and it curves vertically to the lines given on the sheer plan. I fitted it first to the deck and bulwarks, then to the outside curve. The inside must curve to correspond. Finally the top curve is formed and that edge is made vertical to receive the taffrail abaft.

The ends of the bulwarks are then cut to the same curve and above to the correct angle to take the taffrail. The latter projects beyond the bulwarks, is level with the counter, and curved above more than the camber. It is also curved athwart. I carved a rope pattern round the top and sides, painted the ship's name on it, and cut out of cardboard a little eagle and two stars for decoration. The taffrail has to be slightly notched at the corners so that the boat davits will lie flat on the main rail. I strengthened this part with two knees cut to the inside shape and set into the deck, and also with knees in the corners, coming down onto the waterways.

The junction of the bulwarks and the hull is covered with a narrow molding, a bare 1/16 in. square, with the outside corners rounded. This is glued on and held in position with a few pin points. I painted this crimson.

Along the inside of the bulwarks, the timberheads should be shown. These are supposed to be the ends of the hull ribs, but if we set them from the waterways to the top of the bulwarks, that will do. They are a scant 1/16 in. by a full 1/16 in., and are merely glued in the positions shown. Be careful to have one on each side of the gun ports. They are best cut a bit long, then their ends are cut level with the bulwarks. Hold them to the bulwarks with pliers, or clamps and slice them off with a razor blade, or file them level.

THE main rail comes next. This is ⅛ by 1/16 in. and is glued and nailed along the bulwarks and timberheads, projecting outside about 1/32 in.

Copper sheathing was not usual in vessels of this size. The underwater body probably was painted, but I stained mine brown and lightly varnished it. Hulls above the water line were painted black, green, yellow, and so forth, but black was the usual color and is the best looking, so I made mine black with a red molding.

With this kind of hull, marking the planks looks well if nicely done, but badly done, it is an eyesore. Our ship probably had about thirty planks a side, but this would, on the model, be too close. I gave mine twelve planks. With a piece of paper measure from the deck to the keel at the widest part (V), divide this into twelve, mark these positions.

Materials for Hull

- 4 pc. 7/16 x 3¼ x 12 in. white pine. (Dressed ½-in. pine is 7/16 in. thick.)
- 1 pc. ⅛ x 1 x 3½ in. hard or semihard wood for stem, stern, rudder.
- 1 pc. ⅛ x 3/16 x 10 in. hard or semihard wood for keel.
- 2 pc. 1/16 x ¾ x 13 in. pine or semihard wood for bulwarks.
- 1 pc. ⅛ x 2 x 4 in., or equivalent, hard or semihard wood for catheads, stern knees, counter, etc.
- 1 pc. ⅛ x 1¾ x 2 in. semihard wood for counter and taffrail.
- 40 inches of ⅛ x ⅛ in. semihard wood for waterways and moldings.
- 90 inches of 1/16 x 3/32 in. pine or semihard wood for timberheads.

Scraps of hard or soft wood for deck fittings.

NOTE: All wood to be dressed to correct dimensions as shown in drawings.

At stations III and IX do the same. With a flexible straightedge, draw lines through these, letting the ends run up so that you get a kind of fan appearance at the ends. Scratch a line along these lines and clean them out with a needle file. This is best done while the hull is still on the shaping stick.

Mark in the water line as shown, using a scriber or pencil. Note especially that the water line is not parallel with the keel; therefore raise the bow, at the scarf, 5/16 in. Be careful that the hull is upright and firm.

THE deck can also be scribed to represent planks. Make the lines about 1/16 in. apart and straight from end to end. They can be made with a very hard pencil. Do not score the deck deeply or make the lines very black. The deck should be lightly varnished.

The inside of the bulwarks can be white, red, or other color. A dull red looks well, but I prefer white with red waterways.

Coach colors are, I think, the best for this work, but any color can be used that will go on thin and not dry with a shiny finish. A satiny glow is what is wanted throughout. If the deck is varnished with clear lacquer, then parts cemented to it with a cellulose cement will stick firmly.

Where nailing is mentioned, the best thing to use are ½-in. bank pins (lills). Drill holes to start them right, tap them part way in, snip the heads off, then complete the hammering lightly, which will form a sufficient head.

Any kind of glue can be used, but casein (cold-water) glue is perhaps the best and easiest to work with for the hull, and a cellulose cement for other parts. Both are waterproof.

Next month we will proceed to the deck fittings.

SAILING MODEL OF SHIP REQUIRES HEAVY KEEL

AN UNUSUAL number of readers have recently asked how to modify our plans of the *Hartford, Wanderer,* and other large ships so that the models can be sailed. Briefly, the hull must be made as thin as possible and a deep, heavy keel added. This can be clipped or screwed to the real keel when the model is being sailed. Its weight, which is found by experiment, must be such that the hull floats to the water line. If the model is to sail in any direction with reference to the wind, it is also necessary to contrive some method of swinging the yards. Although working models can be made in this way, a prototype model of a large vessel never makes a really good sailing model.—E. A. McC.

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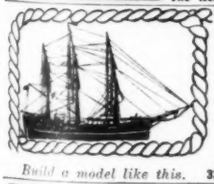

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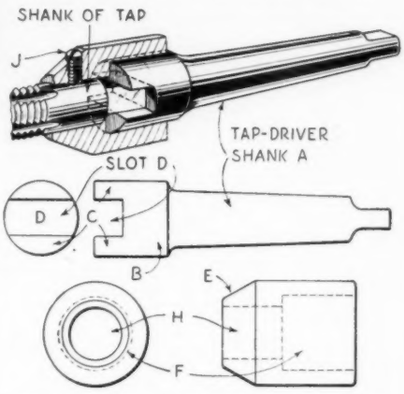
SIMPLIFIED METHOD OF MAKING TAP DRIVERS



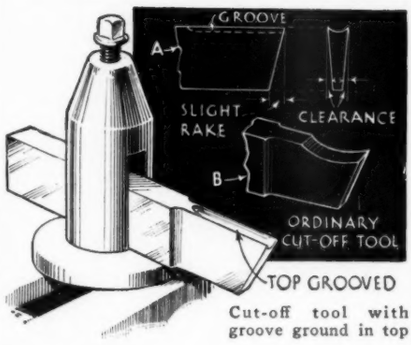
Cut-away view of driver with tap in place, and drawings of the slotted shank and cap

THIS tap driver has replaced one of another design in our plant which was very much more expensive to make. The shank *A* is made of tool steel. The end *B* is turned to a diameter that will allow sufficient metal at *C* to drive the tap after the slot *D* is milled across the face. The slot *D* is about .005 in. wider than the square on the end of the tap.

After the shank *A* is finished, a piece of cold-rolled steel *E* is roughed out with the exception of the hole *F*, which is finished-bored to a shrink fit on the diameter *B* of the driver. After it has been shrunk on, the taper shank *A* is placed on the spindle of our tool-room lathe and finish-turned all over. The hole *H* is bored to fit the shank of the tap. We then drill and tap for a headless set screw as shown at *J*.

A spot is ground on the shank of the tap to receive the point of the set screw, the duty of which is only to keep the tap from falling out.—CHARLES C. TOMNEY.

GRINDING CUT-OFF TOOL



Cut-off tool with groove ground in top

IF GROUND as shown at *A* in the accompanying sketches above, a parting or cut-off tool will cut perfectly true and straight and not pull over to one side as so often happens when it is ground in the ordinary way as at *B*. A groove is ground on the top of the tool instead of a notch. With this tool one can obtain speed with less danger of breakage, and it is equally efficacious on cutting off steel or brass.—ALLAN B. SHAW.

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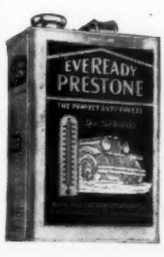

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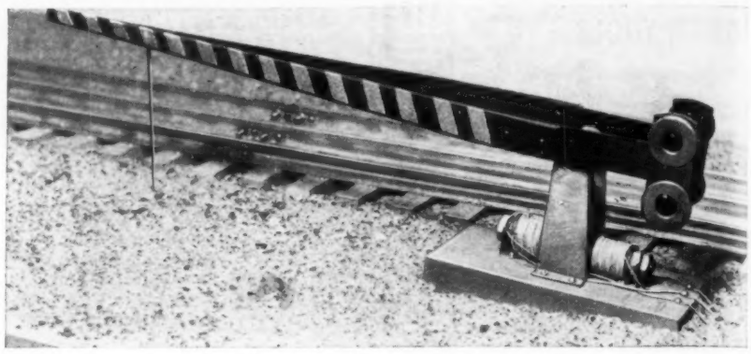


Easily Made Automatic

Model Crossing Gate

NOTHING will add more to the realistic operation of a model railroad than automatic accessories such as the crossing gate illustrated. It is simple to make and costs nothing, as the materials usually may be picked up around the shop.

The two uprights are of tin, ¾ by 2 in. A notch is cut in the center of the top edge of each to provide a bearing for the gate-arm fulcrum. At a point 1½ in. from the base, a ⅛-in. hole is drilled through both uprights for the bearing rod of the swinging armature. The armature consists of a piece of soft iron 1¼ by ¼ by ⅛ in., with a piece of ⅛-in. inside diameter copper tubing soldered to one end as shown. A piece of tin ¼ in. square is soldered to the bearing on the side opposite the armature. The armature is mounted between the uprights and is actuated by the two magnets mounted on the base in the position shown. These magnets are 1-in. stove bolts wound with 200 turns of No. 27 copper wire. The distance between the armature and the core of each magnet should be about 3/16 in. when the armature is hanging free.

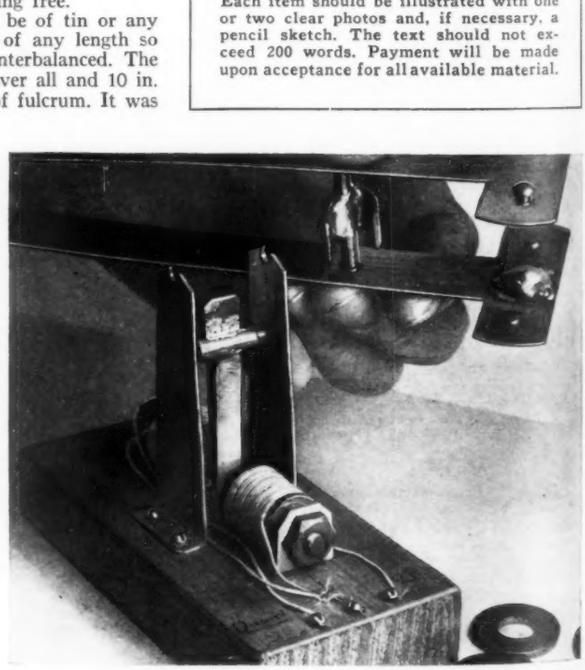
The gate arm itself may be of tin or any light wood, and it can be of any length so long as it is perfectly counterbalanced. The gate shown is 12 in. long over all and 10 in. from the tip to the point of fulcrum. It was counterbalanced by hanging ⅜-in. cut washers at the sides as shown. Solder was also used to offset the difference in weight between the washers and the weight needed to balance the gate perfectly. An angle of tin was soldered in position on the gate-arm fulcrum as shown in the second photo. When the gate is either up or down, one leg of this angle should be in contact with the small piece of tin on the armature.

The gate is installed by mounting a contact of thin brass, 2 in. long, three rail lengths either side of the gate location. They are mounted alongside the third rail, close enough so that the shoe on the locomotive forms a bridge between the contact and the third rail. One wire from the "down" magnet is lead to the entering contact, and one from the "up" magnet to the leaving contact. The remaining wire from each magnet is connected to the outside rail of the track.

In action, the locomotive third-rail shoe forms a bridge between the "down" contact and the third rail, energizing the "down" magnet. This snaps the armature over and starts the gate down. The gate, being free and balanced, continues to travel down until the other leg of the angle is in contact with the tin finger on the armature. When the "up" magnet is energized, the action of the gate is reversed.—DANIEL REYNOLDS.

Wanted . . . from Model Railway Fans

short articles, hints, and suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words. Payment will be made upon acceptance for all available material.



A close-up of the operating mechanism of the gate. The arm is balanced so that a snap of the armature will start it up or down

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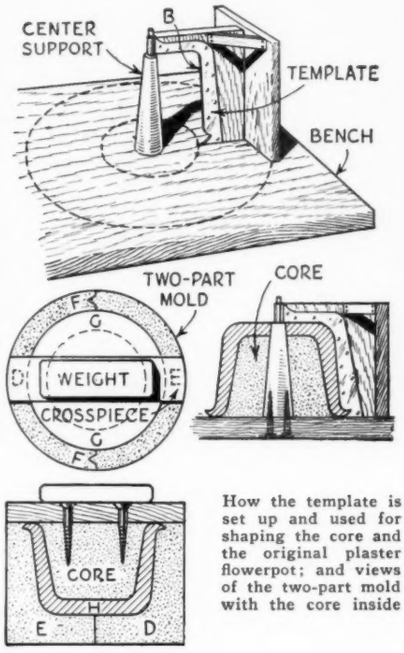
A zinc template is first constructed. Line *B* represents the outside contour; and after the complete core is turned, the template is



How the template is set up and used for shaping the core and the original plaster flowerpot; and views of the two-part mold with the core inside

cut to this outside line. The core is turned from plaster of Paris by the method shown and shellacked. When the shellac is dry, the surface is oiled with lard oil or kerosene and wax. The template is next cut to the line *B* and the edge is filed very smooth. A plaster flowerpot is then made over the core, and the outside is turned with the template. The plaster pot may be lifted off the core easily. It is shellacked and, when dry, oiled.

A plaster mold is now made in two pieces. *D* is first made, and at *F*, conical holes are drilled into the edge of the mold. When the plaster is hard, the edge is shellacked and oiled, and *E* is built up against *D*. The projections on *E* that fit into the two holes *F* will act as locks. Before going farther, it is necessary to fasten a crosspiece to the core with large wood screws. The core can then be removed and the mold (*D* and *E*) taken apart and separated from the pattern, after which the mold is dried, shellacked, and oiled.

To make a casting, the mold is assembled as shown, with a weight resting on the crosspiece of the core. The marble mixture or scagliola is poured into the mold through the openings *G*. Allow plenty of time for the cement to set and harden before separating the mold and removing the finished work, which is marked *H*.

For outside work, which must be waterproof, I use white Portland cement instead of Keene's.—EBERHARDT P. NICHOLSON.

Because of the great demand for our annual Home Workshop Index, the issues for 1933 and previous years have been entirely exhausted. No further orders can be filled.

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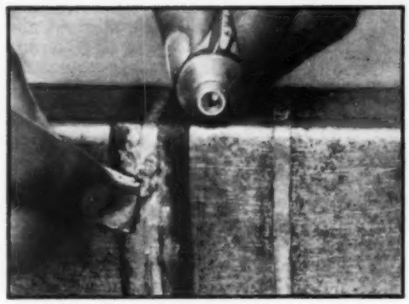
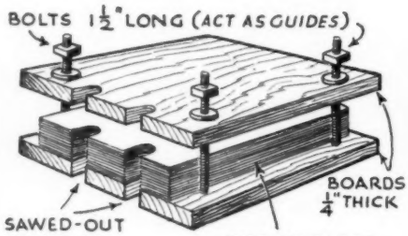


The "solder" is laid between doubled strips of friction tape, which are later torn off

MANY of the patching and leak stopping jobs done with cold or fluid "solder" are not particularly workmanlike because it is quite difficult to lay on the silvery colored cement in an even line. This can be accomplished easily, however, by doubling two pieces of electrician's friction tape and sticking them along each side of the crack, or wherever you wish to run the patch line. Then lay the solder between the strips. If the solder is filled in flush with the doubled tape, it will usually be thick enough. When the composition is hard, tear off the tape and scratch the top of the solder to remove the feather edges.—FRANK W. BENTLEY, JR.

JIG SAW CUTS BINDER NOTCHES IN PAPER



The paper is clamped between wooden forms so that the notches may be cut on a jig saw

A JIG saw can be used for making odd-shaped cuts in paper, such as the U-shaped notches sometimes required to make filler sheets fit a ledger binder. This is particularly helpful in job printing plants.

First take two boards about ¼ in. thick and about ½ in. larger than the sheets to be cut. Lay the sample to be cut on the boards and trace around the cut-out parts. Bore three holes in the corners of the boards as shown and insert bolts about 1½ in. long. Place the boards, bolted together, on the jig-saw table and cut along the lines traced from the sample. Then clamp a pile of paper about ½ in. thick between the boards and proceed to saw around the cut-out parts of the boards, but do not cut into the wood. The bolts serve as guide pins to rack the paper evenly.—WOODROW M. AUDRITSH.

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WHILE camping, particularly during wet weather, it is often convenient to have material at hand with which a fire can readily be kindled. Sawdust saturated with kerosene and kept in a covered jar or tin is satisfactory for this purpose. Several spoonfuls of it will enable one to dispense with kindling if the wood is dry, and a somewhat larger quantity will ignite wood which is damp. In lieu of sawdust, wood ashes may be used.—N.C.

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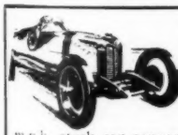

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FLOWERS' SECRET HISTORY TOLD BY MICROSCOPE

(Continued from page 41)

plant in a protective shipping container, a plant that has decided to stop growing until it can find the needed space, moisture, food, and warmth.

You will find the study of seeds fascinating. Your microscope will show you unexpected wonders in the form of ingenious barbs by which the seed attaches itself to an animal's fur, floatation gear that enables it to travel on water, or resistant shells that enable it to withstand digestive actions of a bird or other animal that eats it. The seed has one main idea; to travel as far as possible.

PERHAPS you wonder why a pollen grain doesn't stay at home and grow on the stigma that already is in the flower that produced it. If you can answer that question completely, you will clear away a lot of mystery. It is not quite clear just why cross-pollination, that is, the transfer of pollen from one plant to another, is desirable in most cases. But it is. There are some flowers that do not transfer pollen. Some violets for instance, in addition to producing the usual flowers whose pollen is transferred by bees, develop self-pollinating flowers on rootlike stems that hug the ground. These flowers and the seeds they produce usually are overlooked by the average violet-gatherer. There are, also, some species of plants that produce male and female individuals, so that a transfer of pollen is necessary if they are to reproduce.

Although pollen can be examined in the dry state satisfactorily, you may want to immerse it in some liquid. You will find that the use of water may be disastrous, for some pollen grains burst when wet. Such pollen may be produced in flowers that hang their heads downward so that rain cannot enter them, or others that close at night so that dew cannot get inside and ruin the pollen. Other pollen grains are waterproofed by a coating of oil, so that you will find it difficult to wet them. When such grains are placed in water or glycerin on a slide, they frequently clump together around small air bubbles, and make poor objects to study. In such cases, you will find liquid petrolatum, which is an oil, much better than water. Some of the pollen illustrated was photographed while immersed in petrolatum.

By performing an interesting little experiment, you can persuade some pollen grains to produce pollen tubes, just as they do when uniting with the ovules. Make a weak solution by dissolving some granulated cane sugar in water. Place this in the depression of a hollow-ground slide, or in an ordinary watch glass, add the pollen grains to be germinated, and set the culture away for a time. Examine it every hour or two, for presence of the pollen tubes. It is best to keep the slides or watch glass under a bell jar, in company with a wet cloth or sponge that will prevent evaporation of the sugar water. The cultures in the hollow-ground slides should be provided with cover glasses.

YOU will find that not every kind of pollen can be germinated in this way. Sometimes you must add to the culture medium a piece of the stigma from the flower, before germination occurs. Tulip and narcissus pollen has been germinated in a three percent sugar solution. Chinese Primrose requires a ten percent solution; sweet pea, ten to fifteen per cent, and trillium, about ten percent. Sometimes two or three days are required for germination.

By your explorations amid pollen and stamens and pistils, you have by no means exhausted the store of microscopic wonders of the flower. *(Continued on page 108)*

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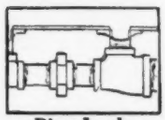
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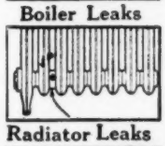
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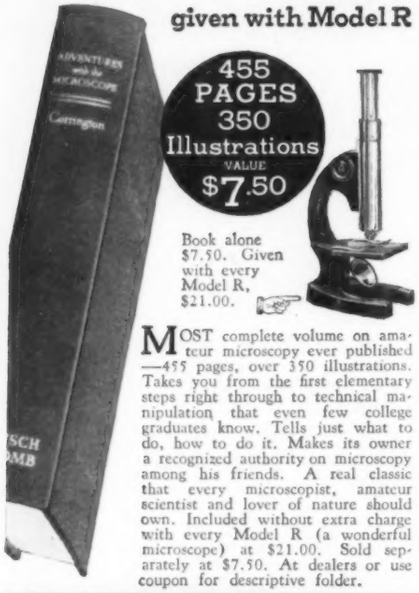

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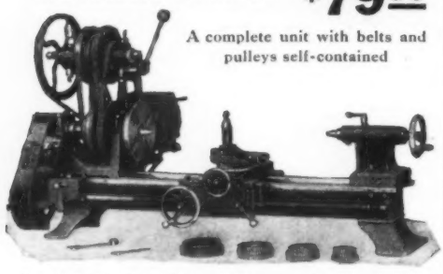

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FLOWERS' SECRET HISTORY TOLD BY MICROSCOPE

(Continued from page 107)

Consider the petals, for instance. Remember that botanists say the petals are nothing more than leaves that have become a bit ritzy. Perhaps you can find a common characteristic that will support this belief.

Examine a pansy or other petal under the microscope. You simply can lay it on a slide and shine a brilliant light through it; or you can sandwich it between slide and cover glass with a drop of petrolatum. Focus on the surface, and you find a beautiful mosaic of cells. Find a spot on a pansy petal where two contrasting colors, such as black and yellow, run into each other, and you can enjoy an unusually beautiful sight. Note that the cells seem rounded and swollen. This is typical of petal cells, and is caused by the great osmotic pressure inside them. That is why petals are so easily injured, for when you crush them you break the cells open.

WITH a needle or scalpel, peel the top layer of cells from a portion of the petal. Place the under layer on a slide and look at it. Move it about until you find a vein that consists of several ducts or water-carrying tubes crossing the microscope field and branching here and there. Close examination shows that the ducts have the coil-spring walls typical of such plant organs. In any leaf you can find these coiled ducts. Here, then, is some proof that petals are nothing more than leaves. Incidentally, the spiral ducts are the same as those you saw in one of the membrane layers of a bean seed, when you examined it a few months ago.

The microscopic exploration of flowers need not be merely idle amusement. If you are a gardener, a farmer, greenhouse operator, or merely an ordinary person who finds pleasure in experimenting with plants, you will find the microscope an invaluable aid in performing cross-pollination, and in doing other experimental work. It is not difficult to learn to identify various kinds of pollen grains by their appearance when magnified. You can study with profit the relation between insects and flowers. Your microscope will assist you in identifying the various diseases and pests that may attack your plants.

Because of the endless variety of flowers, an account of their wonders could go on without end. Unfortunately, this is not possible here, so we must turn our attention to a useful gadget for the microscope, one that will enable you to count with ease the pollen grains or silk strands or whatever else you want to count.

The gadget is a cross-hair diaphragm that, I believe, was designed by the late N. A. Cobb, former expert microscopist of the U. S. Department of Agriculture. When placed in a Huygenian eyepiece, adjacent to the circular diaphragm already there, it turns the microscope field into a square that is subdivided into smaller squares by the cross hairs. It is an easy matter to count the number of objects in the field, by counting those in each small square, and then adding. By examining objects whose size you know, you can determine just how much area the square includes for various magnifications, and thus give a definite value to your measurements.

THE diaphragm consists of a circular piece of thin metal with a square hole cut in its center. Across this hole are parallel, equally spaced strands of spider-web silk, half of them running at right angles to the other half, so as to produce squares. Bronze or brass shim metal, obtainable at almost any garage or auto supply store, makes excellent material for the diaphragms. You can use any other fairly *(Continued on page 109)*

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381 Fourth Ave. New York, N. Y.

FLOWERS' SECRET HISTORY TOLD BY MICROSCOPE

(Continued from page 108)

thin, non-corroding material as well. Cut the piece in the form of a circle that will fit snugly inside the eyepiece tube. Then, with a fine jeweler's saw, chisel, or other tool, make the square opening. Usually two pairs of silken strands, giving nine small squares, are sufficient. Therefore, with a ruler, divide each side of the square opening into three equal parts, marking lines across the metal with a sharp needle. Around the circumference of the diaphragm make small notches at points where the cross marks intersect.

Stick two pins into the edge of a piece of wood or cardboard, and use this tool to collect the spider web, the strands being caught so that they stretch between the pins. With a small brush remove any dirt that may be clinging to the silk. Carefully stretch the strands one at a time across the opening in the metal disk. They will fall across opposite pairs of notches. A tiny speck of balsam placed beforehand in each notch will anchor them securely. In gathering spider-web silk, avoid the kind that runs spirally around the large orb webs, for it contains beads of sticky material. Finally, touch a little balsam to the lower side of the metal plate and lower it carefully into the eyepiece tube until it rests against the circular diaphragm already there. The spider web will last indefinitely if it is not disturbed. In cutting the square opening be careful not to get it too large, or the corners will be masked by the circular eyepiece diaphragm. If your microscope does not use the standard Huygenian eyepiece, a little experimenting will reveal the position at which the auxiliary diaphragm must be placed in the one you have, so that your eye sees a sharp image of the silk strands when you examine an object through the instrument. To prevent bothersome reflections, the metal disk should be blackened with India ink, black lacquer, or thinned shellac to which some lamp black has been added, before the spider web strands are added.

STRANGE BIRDS FOUND ON ISLAND OF HAITI

A BIRD the size of a bee and an "apartment-house woodpecker" were curious discoveries made recently by Dr. Alexander Wetmore, Assistant Secretary of the Smithsonian Institution, during a survey of bird life on the island of Haiti. Found among the highlands, the bee-bird is known as the Hispaniolan vervian hummingbird. In spite of its tiny body, Dr. Wetmore reports, it will attack other birds as large as thrushes when it is aroused. The woodpeckers, contrary to the custom of northern birds of the species, drill their nests close together in the trunks of hardwood trees. As many as a dozen families were found living together in one section of a tree trunk.

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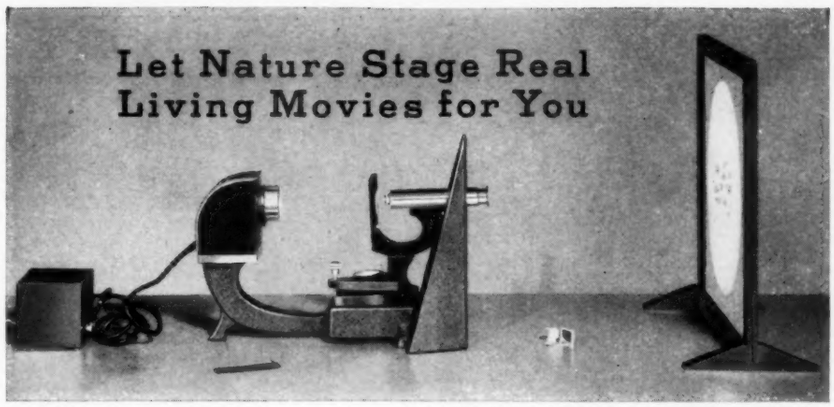

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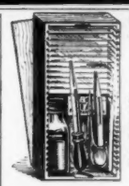

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"AIRPLANE DUSTING" IS UNIQUE AND PROFITABLE

TWELVE years ago, Leslie M. Boyd was a barnstorming aviator. Today he is a highly successful dust scatterer. If that does not mean anything to the average reader, it may be amplified by saying that he is the head of the Aero Agricultural Service Co., and this may be qualified still further by saying that it is a company which furnishes a complete aero-agricultural service for dusting fruit orchards and all sorts of "low" crops with chemicals to rid them of insect pests. On occasions he also sows grass seed and distributes fertilizers from airplanes.

When he entered this field of specialization in 1928, he had just cash enough to supply himself with a plane and to keep himself going for a time until he could perfect his own apparatus and do some demonstrating. His first two years were given up almost entirely to study of the subject, perfecting equipment and giving free demonstrations in the Pacific Northwest at fairs, etc., where crowds of agriculturists were to be found.

In 1929 he was ready to start out in earnest to build a business. He had just one plane then and one helper. Today he has three planes, three pilots besides himself, and one licensed mechanic. The planes are all equipped with special hoppers, which he has designed and built himself in his own shop, for distributing the chemicals. Ordinary commercial planes are employed, but they are largely rebuilt and adapted to the special service.

DUST comes out of a specially designed hopper with feed valves. It is ejected under the plane in a certain way to take advantage of the streams of air and is given a terrific "roll", distributing itself evenly over a swath from 50 to 150 feet wide.

Boyd goes out in the fall and makes blanket contracts with farmers and ranches, covering protection of their crops the next year. Then he makes a complete study of each individual ranch or orchard, or sometimes groups of them where they are signed up close together. He studies the plant pests that must be combatted and determines what must be applied as a remedy, how and at what times.

Last year he specialized on hops. On a single contract he applied over 37,000 pounds—over 18 tons. An onion grower got 12 tons in *(Continued on page 111)*

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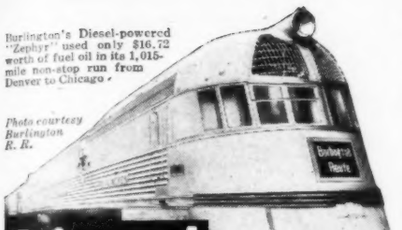
Burlington's Diesel-powered "Zephyr" used only $16.72 worth of fuel oil in its 1,015-mile non-stop run from Denver to Chicago.

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"AIRPLANE DUSTING" IS UNIQUE AND PROFITABLE

(Continued from page 110)

two applications. A low crop farmer got nine tons, and so on. Last year he applied well over 100 tons of chemicals from his three planes. Application is made from a height of 5 to 25 feet, going at a hundred miles an hour or so. If anything should go wrong, the "duster" would have to zoom for it mighty quick to get a comfortable altitude. Yet, he says it is not particularly dangerous.

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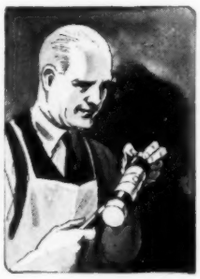

SPECIALIZING in one certain article that has only a limited sales possibility, might not sound like a very promising proposition to the average manufacturer, but B. C. McGowan, of Dallas, Texas, makes it pay.

Mr. McGowan is an enthusiastic devotee of the game of Roque, which is a glorified cross between the games of croquet and billiards. Hard rubber balls, three and one-fourth inches in diameter, instead of the familiar wooden croquet balls, are used in this game which is played on a ground somewhat similar to a conventional croquet court, but surrounded by a low concrete wall from which the balls may be banked, as in billiards.

These hard rubber balls greatly improve the quality of the game by adding to the accuracy of the "shooting" and by increasing the rebound from the "bank", but their added weight and hardness would ruin the average croquet mallet in one game. Many players made an effort to reduce this excessive wear by tipping their mallets with rubber, fiber, or steel, but while some of them achieved a certain amount of success by these methods, Mr. McGowan was not entirely satisfied with the results *(Continued on page 112)*

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Secrets of Success

MAKING MONEY FROM CROQUET MALLETS

(Continued from page 111)

An expert mechanic, he thought he knew how a mallet should be made and constructed one according to his own ideas.

Other players liked his new mallet so well that he soon had a number of requests on his hands for more like it. These requests gave him the idea of making the mallets for profit and he was soon using the greater part of his spare time in manufacturing them.

His success has not been startling, but a combination of good workmanship and careful selection of materials, together with a thorough knowledge of what it takes to make a good mallet, has made every user of his product such a booster for him that his business has increased steadily from its very beginning. Experiments to improve the quality of his merchandise have been so successful that his mallet is now known and liked all over the state of Texas, with orders often received from more distant points as players from other states hear of his mallet and investigate its possibilities.

The necessity of speeding up production as business improved has caused Mr. McGowan to add to his original equipment from time to time, until today he has one of the most complete home workshops in existence. A visit to his neat, efficiently arranged workshop is an eye-opener indeed. Profits that often run from thirty-five to fifty dollars in a single week from spare time work and a small investment, are certainly not the result of an accident.—O.R.M., Dallas, Texas.

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Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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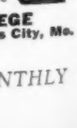

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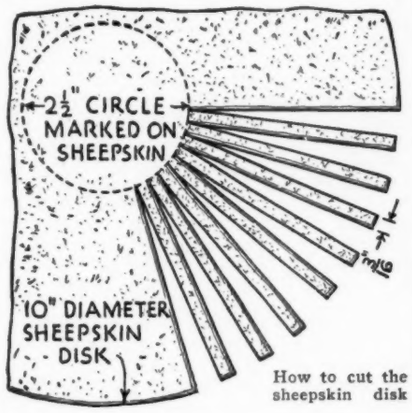
CIGARETTE JAR COVERED WITH WOVEN LEATHER

THE cigarette humidor illustrated is made from a glass jar of the type in which cheese spread is sold and is 2⅝ in. in diameter and 3⅛ in. high. The covering is sheepskin, suède side out. Any color may be used.

Strips of sheepskin hide the glass jar

Lay out a 10 in. disk of the leather as shown and cut the 3/16-in. strips from the edge to the center circle all the way around. Then, from another disk, cut a ⅛-in. strip 10 ft. long, cutting around the piece until the required length has been obtained. Set the jar in the center of the 10-in. disk and begin weaving the ⅛-in. strip around the jar, alternately over one and under one. Carry the work up to the shoulder of the jar; then run the ⅛-in. strip around once, glue the end down, and cut the upright strips off so that they come about ⅜ in. above the last weave. Apply glue to the end of each strip, bend it down over the last weave, and hold it until the glue sticks.



How to cut the sheepskin disk

The cover is made by wetting a 3¼-in. disk of the leather and stretching it down over the original cap of the jar. Glue this tightly to the cap.

A larger jar may be covered in the same way for a tobacco humidor, and leather of two colors may be used.—DICK HUTCHINSON.

The completed cigarette container and, at right, the cheese jar from which it is made

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WORLD'S STRANGEST CIRCUS IS PRODUCED BY AMATEURS

(Continued from page 52)

single trapeze performers and others who work on the loop-the-loop trapeze, spanish web, roman rings, aerial cradle, and double trapeze. The animal acts include juvenile and adult bareback riders, high-school and liberty horses, and a high-diving dog. The ground numbers include two tight-wire acts, juvenile and adult tumbling groups, and horizontal-bar artists. The clown numbers feature comedy acrobats, bucking mules, a synthetic giraffe, a funny Ford, and the clown firehouse act, as well as numerous clown walkarounds on the track which take up time between numbers as rigging is being changed by the property men.

IN THIS diversified program are several features which would do credit to any circus program. Little Jimmie Scruggs, an eleven-year-old school girl, performs on the loop-the-loop trapeze. Mrs. Geraldine Murrell, young society matron, supports the weight of a 200-pound man on a rope looped around her waist as she does a split on the roman rings. Margaret Talley, beauty shop operator, throws her body over a trapeze bar in a muscle-grind endurance test as many as 103 times at a single performance. Verne Brewer jumps a table held above his tight wire, and Camilla Williams does a split while performing on a tight wire. Virgil Keel's troupe of bareback riders offers a unique feat, two girls mounting the shoulders of George Tyler, gasoline filling station operator and principal rider, to do a "three high" on the galloping horse. And the feature of the acrobatic act is a "basket" somersault by young Joe Pettit, Jr., twelve-year-old son of the postmaster-clown, who stands on a basket formed by the arms of two fellow acrobats and is tossed into a backward somersault to land standing on the shoulders of another youth twenty feet away.

Most of the equipment used in the circus is homemade under the direction of W. A. Murrell, who is general superintendent of the circus. In several instances, it has been necessary to invent equipment for certain acts. This is true in the case of the loop-the-loop trapeze. The amateur performers had seen such an act in a professional circus. An aerial bar was attached to steel uprights instead of ropes, and standing on the bar the performer revolves around the crane bar. Using steel tubing and two discarded automobile bearings, a satisfactory loop trapeze was made in a Gainesville machine shop.

THE funny Ford used by the clowns, which apparently is operated without a driver, was a stock car donated to the circus by a Gainesville automobile dealer, and transformed into a trick machine by Lloyd Saunders, an automobile mechanic, who is the circus's volunteer electrician. Saunders removed the back seat of the machine and arranged a covering of upholstery which gives the effect of a back seat, but allows a driver to sit on the floor of the machine with his back resting against the rear of the car, and hidden from view by the false seat cushion. The driver's quarters are so small that the steering wheel is removable and is fitted onto a short vertical steering post between the driver's legs only after he is seated. Pedals for clutch, brake, and gearshift are set in the floor of the machine under the front seat and made workable by iron rods connected with the regular pedals. The hidden driver operates a starter by hand, and in addition to driving the machine, fires a revolver for blow-out effects, operates an air compresser which squirts a stream of water from the radiator, blows a horn and rings a bell for a telephone attached to the side of the car.

The trampolene bed used by the clown acrobats is still another example of ingenuity called forth by lack of capital. The trampolene consists of an iron frame seven feet wide and fourteen feet long resting on legs two feet high. Stretched in the frame is a canvas bed on which the acrobats bound. Lacking the trampolene springs used by professional artists, the resourceful amateurs made a bed of fourteen-ounce canvas doubled and securely sewed, and attached it to the frame with strips of discarded automobile tire tubes, one inch wide and spaced two inches apart along the sides and ends of the canvas. While the strips of rubber must be frequently replaced, the bed has sufficient spring to allow for double somersaults and other straight and comedy effects.

DURING the performances the equipment is handled by fifteen property men who volunteer their services. These property men include among others, a civil engineer, an insurance salesman, a dry-cleaning plant operator, a city street department foreman, and several college football players.

When the circus goes on the road, the paraphernalia is moved from town to town on trucks. On show day, the performers go about their daily tasks as usual and leave Gainesville late in the afternoon, motoring to the scene of their night's performance. They return home after the show and the procedure is repeated each night of the engagement. Thus they do not lose any time from their regular employment. Citizens of Gainesville volunteer the use of their automobiles to transport the performers.

The circus is governed by a board of directors. George J. Carroll, a mortician, is president; Dr. Jerry C. Price, a physician, is vice president; and D. E. O'Brien, a bank cashier, is secretary-treasurer.

The membership is democratic to the extreme, and no person of good character who wishes to belong, is refused admittance. There are no dues and no by-laws. In the ranks are society leaders and railroad brakemen; city officials and messenger boys; bankers and newspaper reporters, lawyers and ranchmen.

There are few circus "widows" for when one member of a family joins the circus, others follow. Mayor Frank Morris, Jr., is snare drummer in the circus band and his son, Fletcher, is an acrobat. Floyd Garrett is chief rigging man and his wife, Sarah, is an aerialist. Yancy Culp is an acrobat and his wife, Mildred, is wardrobe mistress. Portis Sims is the female impersonator of clown alley, and his daughter, Jane, is a trapeze performer.

ALTHOUGH the show has been in existence for five years, none of the members have graduated to the ranks of the profession. Salaries are notoriously low in the small traveling shows and while numerous offers have been made to members of the amateur circus, in every instance the opportunity has been declined.

"What if I did join a real circus?" says Ray Whittaker. "When I came back home they wouldn't let me take part in the community circus, for then I would be a professional. No, sir, I'll keep my amateur status."

The various members of the circus give different reasons for the pleasure they find in it. Some like the spirit of cooperation and comradeship it fosters; others are thrilled by the sense of achievement in mastering difficult feats. Gainesville is justly proud of its circus as a wholesome community activity.

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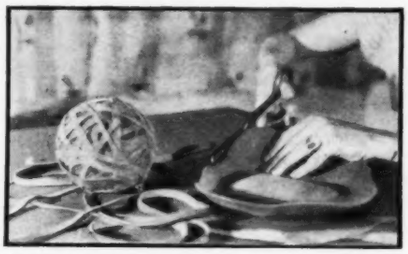
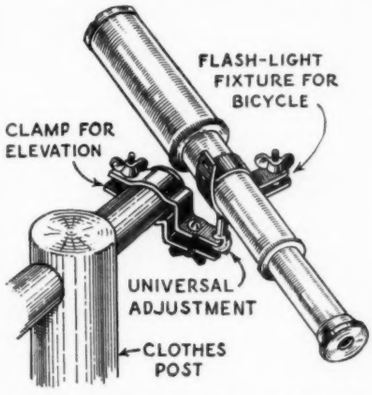


Tin snips are used to cut long strips from the inner tube for winding a playground ball

A BALL of the indoor or playground type may be made from rubber bands cut with tin snips from a section of an automobile inner tube. First cut a disk from the tube as large as practical, then follow around the edge as shown. A cover, cut from scrap or salvaged leather and sewed with linen thread, will prolong the life of the ball and add to its appearance.

A core of another material, such as a hollow ball of celluloid, paper, or even a hollow rubber ball, will help to give size without undue weight.—CHARLES M. RICE.

CHEAP UNIVERSAL JOINT HOLDS TELESCOPE



Small telescope mounted by means of an inexpensive flash-light clamp sold for bicycles

MUCH has been written about homemade contrivances for mounting the small telescopes of amateur astronomers and I have labored for hours with these mechanisms, but an investment of 35 cents finally solved the problem for me. I bought an ordinary bicycle flash-light clamp, which is easily attached to the telescope and can be fastened to any convenient pipe. For my own use I have found that clothes-poles are as convenient supports as anything.—NORTON S. LOVE.

ANNEALING HACK-SAW BLADES AND FILES

HACK-SAW blades, files, and other pieces of tool steel can be annealed dead soft by the home craftsman in the following manner: Obtain a piece of ¾-in. or larger scrap pipe about 15 in. long. Thread both ends and obtain a pipe cap for each end. Insert the pieces, screw the caps on by hand, and throw the pipe into the furnace. Allow it to reach a red heat and remain so for about two hours; then remove and bury it immediately in ashes or lime until cold. Steel annealed in this manner does not scale or burn, and can be filed or cut with cold chisels easily. Hack-saw blades can be bent double and hammered flat without breaking. Temper can be restored in the usual manner.—H. R. S.

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MYSTERIOUS LOST RIVERS RUN MILLS AND POWER PLANTS

(Continued from page 37)

whose discharge has reached measured values of 150,000 gallons a minute, operates a modern hydro-electric plant that supplies current for several near-by communities. Similar use has been made of the waters of other springs, and geologists say that there remains a considerable amount of untapped power in still others. Large power stations have been built at a few large springs along Snake River, in Idaho; and perhaps other stations will be established some day at the other large springs in that region. The great amount of water flowing from these springs, and the fact that it emerges from openings in cliffs high above the river, make them ideal for power purposes.

SOME years ago the flow of the springs issuing from the north side of Snake River between Milner and King Hill, Idaho, was measured, and found to average 5,085 second-feet. At that time, the combined water consumption of New York, Philadelphia, Chicago, Cleveland, St. Louis, and Boston was but slightly more than one-half that amount. These springs, it has been calculated, provide enough water to supply every city in the United States having a population of more than 100,000 with water at the rate of 120 gallons a day for each inhabitant.

In some parts of the United States there is evidence that subterranean streams are flowing over the same courses that they pursued millions of years ago as surface streams. It is as if some giant were to lay a crust of earth over part of the Mississippi River system of today, and create on that crust a new network of water ways while permitting the old streams to continue in operation.

On the South Bank of the Missouri River, about three miles below Great Falls, Mont., are Giant Springs, discovered by Capt. Meriwether Lewis of the Lewis and Clark Expedition in 1804, and called by him "the largest fountain in the United States." The supply system of this spring affords an interesting example of the use of ancient river channels by present-day subterranean rivers.

Before the region was covered with an ice sheet during the glacial age, the Missouri River followed a channel different from that it now uses. It is believed that some of the water from the present Missouri River descends into the earth and flows for a time through the ancient, pre-glacial river channel. Then it pursues a subterranean passage through sandy shale and porous sandstone until it emerges to form Giant Springs, and finally flows back into the Missouri River.

BECAUSE it is not possible to peer into the depths of the earth and see exactly what marvels abound there, geologists must depend more or less on circumstantial evidence when they attempt to chart the courses of underground streams. Large springs, sink holes, and caves containing lakes or streams, are among the natural formations indicating the presence of unseen creeks and rivers. Drilled wells sometimes tap these underground waters, and occasionally there is reported a well from which emerge blind fish that apparently developed in underground waters where they had no need for light-sensitive organs. In fact, there is a fairly extensive world of living things that inhabit the subterranean world. Many of these creatures are either totally or partially blind. Scientists have become acquainted with them mainly through the study of life in large caverns such as Mammoth Cave in Kentucky.

The presence or absence of underground streams depends on the nature of the rock underlying the region in question. Large springs, which indicate the presence of subterranean water channels, occur mainly in places where the water passes through limestone or extrusive volcanic rock. Through countless centuries the ground water in limestone regions has hollowed out large channels. Presence of carbonic or other acid in the water hastens the channel-building process. After the waterways have been formed, the water rushes through them with such velocity that it dissolves very little of the rock, so that when it emerges at a spring it contains a small percentage of dissolved mineral matter. The bluish or greenish tinge frequently noted in the water of deep springs is caused by the presence of tiny particles of matter in suspension.

Large springs and underground channels may occur in volcanic rock that, when it cooled, became broken and cracked, forming paths through which water can flow. Similarly, caverns and crevices can be formed far underground by upheaval and shifting of rock that is not volcanic.

Conditions favorable for the operation of underground streams that frequently produce large-sized springs are found in various parts of the United States. These include Florida and adjacent parts of Georgia and Alabama; Northern Alabama and adjacent areas; the Ozark region of Missouri and Arkansas; Texas, where springs occur in the Balcones fault belt; the Snake River basin in Idaho; the Klamath, Deschutes, Willamette, and Umpqua river basins in Oregon; Sacramento River Basin in California; Montana and Northeastern Utah. In all of these regions, springs of the first magnitude are found. Lesser springs occur in Indiana, Ohio, Kentucky, Pennsylvania, and in the great limestone valley that extends from Virginia to Pennsylvania and includes the Shenandoah Valley of Virginia.

ALTHOUGH underground streams remain a mystery as far as their unseen activities are concerned, some of them have been put to work in interesting and profitable ways. The use of large springs for operating mills and hydro-electric plants already has been mentioned. Another common use made of underground waters is the raising of fish for commercial or sporting purposes. Very often the subterranean river water that issues from a spring is of the same temperature the year through, so that it is ideal for fish-hatchery purposes. When the water is fairly cold, trout can be raised in it readily. At Blue Hole, Castalia, Ohio, a relatively small spring when compared with others in the country, a trout hatchery is operated with success. The water, however, has to flow for some distance in the open air after emerging from the spring, before fish can live in it. When it first issues from the ground it does not contain enough dissolved air to enable the fish to breathe.

The presence of a high percentage of dissolved mineral matter in water issuing from underground channels accounts for the existence of various health resorts at the so-called mineral springs. The operators of such resorts are making use of underground streams they never have seen.

The matter of large springs, and indirectly the subterranean streams and lakes that feed them, is being studied constantly by experts of the United States Geological Survey. Besides being of scientific interest, such mystery waters have a high dollars and cents value because they can be put to a wide variety of uses. Further study will doubtless increase our knowledge of these streams, and suggest new ways in which they can be made to serve mankind.

NEW AUTO-DRIVING GAME TESTS YOUR SKILL

(Continued from page 69)

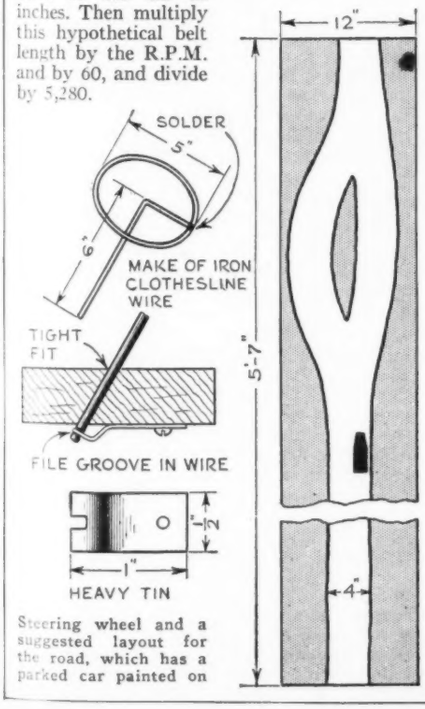
How the front wheels of the toy auto are remounted so that they will steer freely

pulleys to lie snugly in the belt grooves.

The steering shaft should be smooth and unpainted where the threads wrap around it; the rubber bands then will keep the threads tight at all times. The bands should be stretched about 1 in.

The cloth belt, of course, moves toward the driver just as the ground seems to be rushing toward you when behind the wheel of a real car. Run the belt at slow speed at first because you will find that the toy auto is a little harder to steer than a real car. It responds more quickly, and the tendency is to turn the wheel too far. The fact that you are not in the car itself seems to make a difference. At first you will have trouble keeping the car headed straight. At low speeds it is fun to try to follow the curves in the road and to pass the other car marked on the road. If you wish to, you can equip several types and sizes of cars for steering, because one may be removed and another substituted in a few minutes.

To find the relative speed of the car in miles per hour, multiply the length of the belt in feet by 120 and divide by the wheel base of the car in inches. Then multiply this hypothetical belt length by the R.P.M. and by 60, and divide by 5,280.



Steering wheel and a suggested layout for the road, which has a parked car painted on

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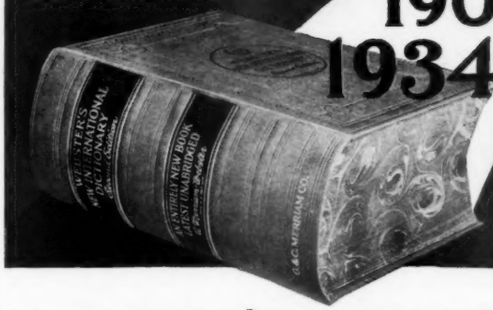

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OH, STAY AWAY FROM ME!—JIM, WILL YOU MAKE THIS MAN LEAVE ME ALONE
SAY, LOOK HERE—ER—LOOK HERE NOW—
AW—SHUT UP SKINNY! ONE MORE WORD AND I'LL KNOCK THE DAYLIGHTS OUT OF YOU—YOU WASH-OUT
1
2
YES—A FINE WASH-OUT YOU TURNED OUT TO BE, JIM MASON!
AW—LISTEN ALICE—I DIDN'T—ER—
THAT NIGHT
A "WASH-OUT," EH?—WELL, I'M FED UP BEING A SKINNY, NO-MUSCLE RUNT. HERE! — CHARLES ATLAS GUARANTEES HE CAN GIVE ME A REAL HE-MAN BODY A NEW WAY.—O.K.—I'LL SEND FOR HIS FREE BOOK AND FIND OUT HOW.
3
4
LATER
CHARLES ATLAS KEPT HIS PROMISE, ALL RIGHT, BOY JUST LOOK AT THOSE BIG MUSCLES! MAYBE I WAS A "WASH-OUT" BEFORE—BUT I'D LIKE TO SEE THAT BIG BULLY INSULT ALICE NOW!
SO YOU ARE PESTERING ALICE AGAIN! WELL, YOU'RE THE WASH-OUT THIS TIME!
OH JIM—THANK GOODNESS YOU HAVE BECOME A REAL MAN!
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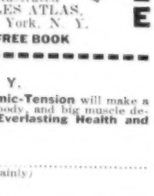

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AMAZING NEW USES FOUND FOR GLASS

(Continued from page 19)

pail that tells the farmer how much to feed his cows. A graduated glass scale, incorporated in the side of the metal pail, records the amount of milk it contains and translates this into the number of pounds of milk. Dairymen feed a certain number of pounds for each pound of milk a cow gives. Thus, the new pail indicates exactly how much food an animal needs and eliminates the necessity of weighing the milk.

Sparkplugs having a core of heat-resisting glass are now on the market. They are designed to let the motorist see the spark and tell if the plug is functioning properly. Glass wallpaper, strange as it seems, is also supplied in standard rolls. It is formed of fine threads of colored glass placed on a paper backing, the hues blending together in novel and brilliant effects.

The fact that glass can be pulled out into the finest threads has given it new jobs to perform. For years surveyors have been having trouble with the sight wires of their transits. Human hairs and spider's webs were tried but they were affected by moisture. Platinum wire proved too brittle. Recently, threads of glass, pulled so fine they are barely visible, have been found adapted to the work.

GLASS wool is made of masses of such threads. It is employed in insulation work and in taking dust from conditioned air. A new air filter developed by the Owens-Illinois Co., using glass wool is reported to extract ninety-nine percent of all dust, pollen, and bacteria from the air that passes through it. Ocean liners, using blankets of the glass wool around steam lines in place of ordinary insulating materials, have been lightened as much as 380 tons, or the equivalent of more than 4,000 passengers. The threads that make up the silky mass are drawn so fine that it would require 2,000 of them laid side by side, in some cases, to cover an inch space. A piece of glass a foot long and two inches square could be drawn into a thread that would reach from coast to coast.

A curious fact about glass is connected with the making of bottles to hold insulin, the gland extract used in the treatment of diabetes. Ordinary glass won't do. The insulin extracts alkali from it and spoils. Only the high silicon content material used in making cooking dishes can be employed in the bottles.

THE story of how a new application of glass is reducing the number of runs in silk stockings comes from an eastern mill. The wooden bobbins in common use, experiments revealed, absorb some of the natural waxes from the silk thread and thus increase its brittleness. By substituting 50,000 glass bobbins for the wood ones with metal ends, this plant has taken a long step toward overcoming the difficulty.

Almost every week, curious orders come to the Corning Glass Works plant. They range from requests for polished plates for sun-power motors to an insulated seven-foot tube of glass in which a patient can be given treatments with high-frequency radio waves. In cooperation with one television inventor, the Corning engineers once designed a glass-scanning disk having sixty lenses ground along its outer edge. Requests have come in for glass teeth, for glass fiddles, for glass coffins. A common demand is for a heating unit having the electric wires embedded in glass.

Frequently in research work, scientists evolve by-products of importance and value. For instance, while experimenting with heat-resisting glassware, they evolved a whole new system of cooking which may prove vastly important in the home. In it, ninety per cent of the electrical energy goes into the food, and the material being cooked is just as well done at the center as on the top or bottom. An ordinary electric bulb in a reflector within a special chamber gives off the radiant energy that does the cooking.

Again, in creating a glass that would absorb ultra-violet light, the experimenters produced a material of such a beautiful yellow hue that it has been employed in art glass under the name of Bristol yellow.

One of the most important developments in the glass world in recent decades was the creation of the heat-resisting glass now used in making cooking dishes and in a hundred and one other ways. Its discovery was the result of researches in railway signal glass.

THE glass used in brakemen's lanterns and signal towers is far from just colored glass. It is a precision product. It is given color tests to be sure its hue will not change; it is ground down to one ten-thousandth of an inch of right dimensions; it is photometered four separate times to determine the amount of light it transmits, and it is given the gruelling heat-shock test in which it is first heated with a flame and then plunged into ice water.

It was while seeking to develop glass less affected by such sudden extremes of temperature, so that lantern globes, for instance, would not break when struck by thundershowers, that the men evolved the formula for the revolutionary glass that has hundreds of diverse applications.

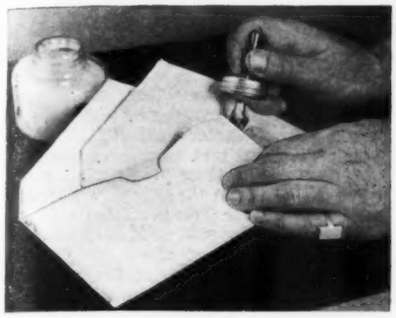
Will colored windowpanes chase away house flies? Seeking an answer to that question, English scientists recently fitted up a strange laboratory-house on the outskirts of a city. They put in windows that were tinted blue, green, yellow, and red in addition to the ordinary white. Then they sat down to watch for house flies. At the end of the test, they had this interesting fact to report. The flies flocked to rooms having white, blue, and green windows but they shunned the rooms with the red and yellow panes. Why? The experimenters have not yet answered that question.

NOT long ago, a southern scientist, Prof. C. A. Basore, of Alabama Polytechnic Institute, Auburn, Ala., announced the discovery of a method of turning waste blast-furnace slag into glass. His laboratory experiments showed that a good grade of green glass can be obtained by grinding up the slag, adding fine building sand, soda ash and hydrated sodium sulphate, and melting the mixture at a temperature of 2,500 degrees Fahrenheit. Heat can be conserved in the process, he suggests, by pouring the red-hot slag directly from the furnace into a fire-clay crucible instead of letting it cool.

An entirely new principle in heating, known as "diffusion combustion," is reported by a Toledo plant. It is said to produce better glass, a "metal" that will flow more easily into machine molds and that will produce finished wares having seventy-five per cent fewer flaws. High-pressure radiant flames of great penetrating power are applied so they cover the glass in the melting tank completely. The usual cross-fire method of heating is said to be less uniform in its results.

The first factory in America was a glass works. In 1609, a plant for making colored beads and glassware was turning out its crude product on the James River, at Jamestown, Va. Three and a quarter centuries later, in the midst of an Age of Glass undreamed of then, research men are busy making new discoveries, devising new methods, opening up new fields, pushing ahead toward dramatic possibilities which still lie in the future.

MAKING LONG ENVELOPES FROM SHORT ONES

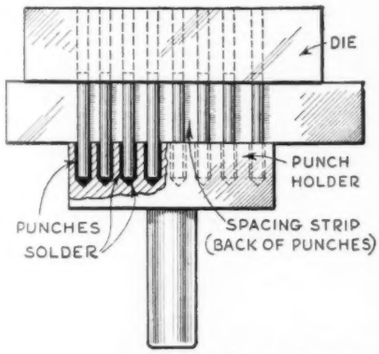


How two short envelopes are cut and pasted together in an emergency to form a long one

WHEN a long envelope is not at hand and it is desired to mail a letter or other material that is larger than the usual small envelopes, two of the latter can be used to make one large one. One end of each small envelope is split open; they are then joined, telescope fashion, to the length desired and the joint is pasted firmly. It will be found that the combination envelope is entirely satisfactory.—E. V. BURNHAM.

HOW TO LINE UP SMALL PUNCHES ACCURATELY

TO LINE up punches for thin metal requires great skill and patience. My method of doing this is as follows: Drill holes in the punch holder about 1/64 in. larger than the punches. Harden the punches and tin them on the ends. Then fill the holes in the punch holder with solder, place each punch in turn



The die itself is used for lining up the punches while the solder is still molten

in the bench vise, heat the tinned ends with the torch, and insert the punches in the holes prepared for them. Place a spacing strip on the punch holder as shown, heat the punch holder again until the solder runs, and then place the die in position. The die will line the punches up correctly provided the solder is still warm enough to run. I have never seen punches come loose once they had been applied in this way.—CHARLES KUGLER.

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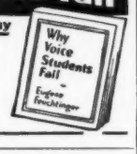

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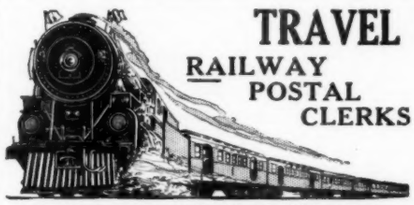

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SAFE STUNTS WITH FIRE FOR THE HOME CHEMIST

(Continued from page 57)

of the oil should, of course, be used.

When accurate results are desired, these flash and fire tests should be performed in the absence of drafts. A direct draft on the test apparatus will tend to cool the surface of the oil and may raise the flash and fire points. Also, it is well to use the same size pilot flame in each of a series of comparative tests.

HOW DO *You Pronounce Iodine?*

A questionnaire sent recently to 400 of the world's leading chemists has at last provided a standard for the pronunciations of many common chemical names. A tabulation of the answers shows that iodine, for instance, is almost universally pronounced "iodeen," while chloride takes the form of "Klorid" as if it ended with the word rid. "Sit-rate" received the most votes as the correct pronunciation of citrate and oxide is pronounced "oxid" by most people who should know. Quinine, whose pronunciation has long been disputed has two accepted forms; "kwi (as in quill)-neen" and "kwinine" with i's long as eye.

Just as chemicals can be used to promote combustion, they also can be used to prevent it. Both wood and cloth can be fire-proofed through the use of simple chemicals. To demonstrate this, dissolve about five teaspoonfuls of ammonium phosphate in two or three teaspoonfuls of water. Immerse a small square of cloth in the liquid, allow it to soak for a minute or so, and then hang it up to dry. Finally, try to ignite the cloth with a match. Although it may scorch or char, it will not burst into flame as readily as cloth of the untreated variety. If ammonium phosphate is not available, ordinary alum dissolved in water can be used.

Wood can be fire-proofed in a similar way by using sodium silicate (water glass). As an experiment, paint a narrow band of the chemical around a large kitchen match stick about an eighth inch or so in back of the head. When the water glass has dried, strike the match. It will burn brightly until the flame reaches the treated wood. Trick matches that will go out as soon as they are lighted can be made in this way by the home chemist whose friends are continually borrowing a light.

GUM DROPS AND SALT KEEP WORKERS COOL

Gum drops and salt tablets were the strange diet eaten by steel workers in a mill at Brackenridge, Pa., to cool them off during last summer's heat waves. Men who ate the candy and salt tablets, officials declared, were able to carry on their tasks without the interruptions usual with steel workers in hot weather. The gum drops, they said, replaced the glucose lost in perspiration while the tablets replaced the salt.

HOMEMADE PLANETARIUM FOR THE AMATEUR

(Continued from page 47)

rubber band that represents the ecliptic.

The dime also enables you to demonstrate beautifully how the sun in our northern latitudes rises north of east during summer, south of east during winter, and straight in the east at the spring and autumn equinoxes.

To demonstrate these points, place a dime at the points where the ecliptic and equator bands cross. If the flask is rotated around its glass rod axis after each shift of the coin, the rising points can be noted.

While doing this it is also fun to measure from horizon-rising points to horizon-setting points along the ecliptic band. The distance which the dime is above the horizon will be found considerably longer and shorter respectively in summer and winter. With the dime at the equinoxes, however, the tape will measure just half the circumference of the flask from horizon to horizon in either direction. In other words, day and night (nox) are equal (equi) at the equinoxes.

AN INTERESTING variation of this experiment is to consider the dime as the silver moon and place a copper cent for the red sun. The sun should be placed under the ecliptic band just opposite to the moon. We can then demonstrate that when the summer sun is high in the sky, the summer moon is running low. Also, when the winter moon rides high, the weakened sun travels low across the southern sky.

Finally, let us try an experiment with three dimes at the three successive positions of the moon during its monthly progress around the earth. When placed under one part of the ecliptic band, the dimes arrive on successive days at the horizon with the ecliptic at a very sharp high angle with it. This occurs in spring and results in long intervals between one time of full moonrise and the next. The delay in moonrise caused in this way may be as much as an hour.

But when the three dimes are shifted to a part of the ecliptic band which is at a low angle with the horizon, the delays between successive moonrises are much less. This condition occurs in autumn, and results in the short intervals between times of full moonrise which are called "Harvest Moon" in September and "Hunter's Moon" in October.

THE experiments outlined in this article by no means exhaust the possibilities of the parlor planetarium. It is a fascinating toy to have around for continued experiment. It has, in fact, been suggested that (with a suitable decorative base) a parlor planetarium might be an interesting permanent mantel or table ornament.

METEORS ARE HEARD AS SOON AS THEY ARE SEEN

IN DEFIANCE of known physical laws, sounds given off by streaking meteors speed through the air with the swiftness of light, recent investigations by a Denver meteorist have shown. Amateur observers of a giant fireball which illuminated New Mexico and adjoining states last year reported that the sound was heard at the same instant the meteor was seen. As the ball passed fifty to 100 miles from the observers, ordinary sound would have taken several minutes to travel the distance. It was at first suspected that the observers had been deceived. However, since so many of the reports agreed, investigators were forced to the conclusion that meteoric sound is transmitted in some way other than by air waves. What this method is, and why meteoric sounds should differ from others, is not known.

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WATCH YOUR AMMETER

(Continued from page 64)

small spring balance. "I borrowed this tool from my fishing kit," he said, holding the scale up so Cummings could see it, "and it comes in mighty handy testing distributor springs and brush springs. Here," he added turning back to Cummings' car, "I'll show you what I mean."

When he had loosened the fiber distributor cap, Gus indicated a U-shaped spring on the breaker arm and proceeded to slip a loop of wire attached to the lower end of the spring balance over the tip. "Now this spring has good tension," he explained as he pulled the other end of the balance. "If you'll look closely, you'll see that the balance reads just about eighteen ounces. That's just about what it should be.

"THE same thing holds true for the springs on starting motor and generator brushes," he continued as he reassembled the distributor. "Just hook the balance to the brush arms and pull. The balance ought to show a tension of about twenty ounces."

"Never knew you could use a spring balance round a car," said Cummings with a chuckle. "And I never realized that you could tell so much about the electrical system just by watching the ammeter."

"Most car owners don't realize it," said Gus, "but their ammeter is one of the most important gages they've got. It shows up all sorts of things.

"For instance, if your ammeter reads discharge when both your ignition and your lights are off, it means there's a short-circuit some place in the wiring. On the other hand, if it suddenly registers a higher charge than it should when your motor's running, it's a sure sign that there's a ground or a loose connection at the battery, the starting switch, or the ammeter.

"Or the needle may jiggle back and forth instead of staying steady. That indicates a loose or corroded connection in the lighting system or in the ignition wiring.

"If you're breezing along and your motor suddenly goes dead, a glance at your ammeter will generally help you to find the trouble. The thing to do is turn on your ignition. If the ammeter pointer stays at zero, there's either a break in the primary of your ignition coil or the breaker points have burned away or jammed open. But if the ammeter shows the usual discharge, you can forget about the breaker points and ignition coil primary and concentrate on the condenser, the high-tension winding on the coil, and the high-voltage wiring to the distributor and spark plugs."

"By the way, Gus, speaking of condensers, is there any simple way you can test a condenser when you're stuck miles out on some lonely road."

Gus nodded. "And your ammeter will come in handy there, too. All you've got to do is wedge a piece of cardboard between the breaker points inside your distributor and turn on your ignition. If the ammeter reads discharge, it means current is flowing even though the points are open. The only other route is through the condenser, so it's good proof the plates are short-circuited at some point inside."

"SAY, you haven't got a bottle of glass cleaner or window polish around the garage, have you?" asked Cummings with a grin as he climbed into his car and prepared to drive away.

"Glass cleaner?" questioned Gus.

"Sure, I thought I'd clean up the glass on this ammeter so I can watch that confounded pointer a little easier," replied Cummings with a chuckle as he maneuvered his car out of the garage driveway.

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BORDER GUARD WAGES CONSTANT WAR ON CLEVER SMUGGLERS

(Continued from page 28)

Chinese, mounted patrolmen told me, want to make their future home in San Francisco, while Japanese prefer Los Angeles. In those cities are large colonies of these nationals. Many Mexicans, though otherwise eligible for citizenship, are smuggled in, particularly in recent years, because they cannot hurdle the public charge visa. The price scale depends largely on the distance to be traveled. An alien may find ways and means of reaching Los Angeles, 140 miles north from Lower California, for $125; but if he prefers San Francisco, he must fork over $200. Usually the longer trips are taken in airplanes, a half-dozen aliens reaching their destination in a four-hour flight from some cow pasture twenty miles distant from the border.

SMUGGLERS take unbelievable chances. Not long ago a party of Americans left a southern California airport in time to fly over Rosarita Beach, ten miles south of the boundary. Fog drove them low and as they passed over a clearing at Rosarita they observed a box being transferred from an automobile to a plane. They were so close, one man recognized the pilot.

Unsuspecting, the pilot took off for a point near Los Angeles. Meanwhile the first plane landed at Ensenada, where a curious passenger telephoned to American customs officials, giving the number of the plane.

"Thanks very much," replied the patrolman. "We've been watching that baby. He lands usually on an airport near Burbank."

Two cars of customs officers rushed to the field. Thirty minutes later, the plane appeared, circled, came down for a landing. As his wheels touched the ground the officers dashed out to intercept him, but the wary pilot saw them, gunned his motor and took off. A few minutes later the disappointed officers saw a box drop from the ship, but intensive search failed to bring it to their eager hands. The plane was seized for failing to clear customs, but because of lack of evidence the pilot could not be convicted for running narcotics.

"A gang may specialize in liquor," one border patrolman of long experience told me, "yet if the price is satisfactory they will attempt to bring in aliens or narcotics."

ODDLY, the bigger the gang the more secretly do Uncle Sam's border agents go about the task of bringing its members to justice. Possibly only three or four men will have even an inkling of what's going on until abruptly the staff in a particular district receives orders to spread a net around a delivery point or some isolated airport. Often, in this way, immigration officers will complete a liquor case before passing the information on to customs officers to make the arrests.

Large gangs are known to operate on both borders, plying their nefarious trade in the dark of night. To catch the leaders and present conclusive, convicting proof in court is, however, a difficult matter. Yet their methods are known and in some cases even the leaders' names are contained in confidential reports hidden away in voluminous files.

One western gang has three leaders. It controls fifteen airplanes, with pilots ready to fly to any Mexican or Canadian destination from Pacific Coast cities, load up with contraband, and deliver it anywhere they may be ordered.

"The pilot," a veteran patrolman told me, "never knows to what foreign field he is to fly until he receives orders a few minutes before taking off. When he reaches his destination another agent delivers the load of aliens, alcohol, or dope. Not until then is he told where to land on his return journey with the smuggled goods."

The difficulties of apprehending smugglers under these conditions seem insurmountable. They may choose from an almost unlimited number of fields on both sides of the border, and their modern planes fly over the boundary line at night, so high that not even the roar of their motors can be heard by ground observers.

But the patrolmen gradually move in, stopping an airplane here, another there, until they so cripple the gang financially that it cannot reap the huge profits its greedy promoters visualized.

Take this case. An airplane was seen to land three times on an eighty-acre clearing near Fallbrook, Calif. A large black sedan met it and sped away. The pilot took off immediately and disappeared into the night with nothing to indicate his destination.

THEN the immigration patrolmen went into action. They studied the territory. They noted that an automobile could be spotted from the air if it approached within five miles of the clearing. Two patrolmen drove to the edge of a clump of trees about five miles distant, then walked to the scene of what they hoped would be action. Quietly they crossed the clearing, in the center of which they found a small clump of bushes in which they concealed themselves and waited. Hours passed and they were on the point of giving up the vigil when the glare of headlights swung into the field. The car's lone occupant drove slowly around the borders, circled the island of shrubbery, again traversed the field to make sure no observers were abroad, then stopped a few feet from the spot where the officers lay flat on their faces hidden by the darkness.

As the driver nonchalantly stepped from the automobile a whisper cracked out through the still air:

"You are covered, pardner. Walk over here and don't make any mistakes."

The astonished smuggler moved slowly toward the unknown voice. One officer kept him covered while the other took an automatic from the prisoner's holster. Their instructions were brief:

"Lie down and keep quiet."

Fifteen minutes later, the drone of an airplane engine could be heard in the southeast. Its steady beat grew rapidly stronger, then suddenly stopped as the pilot eased back on the throttle before starting his long glide. Hardly had his wheels touched the earth when a dark figure stepped into the car, drove quickly alongside the plane. The pilot swung the cabin door open, hopped out and lowered two five-gallon cans to earth.

"Give me a hand, Jerry," he said. "I need help."

"More than you realize, my friend," replied the voice within the car. "Stick 'em up and we'll take care of the load."

The "load" consisted of 250 gallons of cargo alcohol.

UNCLE SAM'S mounties of both services patrolled a total of nearly 15,000,000 miles last year in their quest for contraband. In boats, automobiles, and airplanes; on trains and horses and afoot, they seek to stem the tide of illicit entries. An army of nearly 2,000 men spread its thin lines along both borders, keeping watch day and night. In a twelve-month period they will question more than 1,000,000 people in an effort to learn their nationality, residence, and intentions; examine a half-million automobiles, and seize possibly 25,000 aliens and smugglers, a good-sized fleet of automobiles and boats and, occasionally, an airplane.

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HELP HUMANITY!

HERE'S THE ANSWER

(Continued from page 63)

tube should be ample proof that air is one-fifth oxygen.

Wood That Sinks

A. N., BROOKLYN, N. Y. Not all woods float in water. The heartwood of lignum vitæ, weighing from seventy-three to eighty-three pounds to the cubic foot, will sink as will Jamaica or West Indian ebony tipping the scales at sixty-nine to eighty-three pounds a cubic foot. Other heavy woods which may or may not float depending on the specific type are boxwood and greenheart.

Spotted Table Tops

J. B. V., ST. LOUIS, MO. A hot iron, paper napkins, and some oil often are used successfully for removing spots from the polished surfaces of tables. Cover the surface with several thicknesses of paper napkin cut to fit the spot and then apply the hot iron, regulating the temperature so as not to scorch the paper. Remove the napkins after the wood has been thoroughly heated and rub the area briskly with a soft cloth moistened with a few drops of mineral oil. Finally, polish with a dry cloth.

A Universal Word

P. L., BOSTON, MASS. The word "lemon" is one of the most universally used words in the world. With only slight variations, it is used in almost every tongue of the civilized globe.

Origin of Trade Marks

Q.—HOW FAR back can the use of trade marks by manufacturers be traced?—F. K. N., Ann Arbor, Mich.

A.—BECAUSE of the similarity of various groups of letters found inscribed on ancient mill stones unearthed near Pompeii, archaeologists trace the use of trade marks back to the Romans. Their belief is founded on the fact that mill stones of the same general design invariably bore the same group of letters as if to identify the maker.

Underwater Record

H. O. P., LONDON, ENGLAND. Under normal conditions a skilled pearl diver can stay under water approximately three minutes. The record, according to one report, is five minutes.

Gold Filled

Q.—WHAT do the words "gold filled" mean when they are stamped on a piece of jewelry?—D. L. W., Toledo, Ohio.

A.—WITH THE exception of watch cases, the words "gold filled" mean that the article is made of a base metal covered on one or more surfaces with gold alloy. According to present standards, no article whose alloyed gold content is less than one-twentieth can be marked "gold-filled." Also, a recent ruling states that the words "gold filled" must be accompanied by a fraction stating the proportion between the alloyed gold and the entire weight of the metal in the article as well as a figure stating the fineness of the gold. For example, "1/20 12K Gold Filled" means that the article is one twentieth gold alloy and that the coating has a fineness of twelve karats.

Oldest Settlement

R. K., SPOKANE, WASH. The Indian settlement of Oraibi on the Hopi reservation in Arizona is thought to be the oldest continuously inhabited community in the United States. It is believed to have been settled in 1200.

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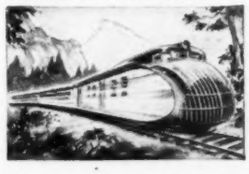

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Fiends of the Desert Found to be Harmless

(Continued from page 31)

with its fangs. At the instant of penetrating the flesh with the fangs, it compresses its jaws, injecting the venom through hypodermic needlelike fangs. And here is where another legend is found false. Removal of the fangs does not render the snake harmless. The fangs are constantly being replaced from behind, requiring only a few days for the process. Poison may also enter the wounds which are made by the smaller teeth.

"Another myth is that the rattlesnake coils to strike. The truth is that the reptile coils to rest. It must uncoil to strike. And there is no need to be panic-stricken at the sight of a rattler. It can strike and throw itself only one half of its length, never its whole length, and regardless of all the hair-raising yarns that have been concocted out of thin air, it cannot leap.

"The snake also doesn't add one rattle each year, as is commonly thought. My observations show that each shedding of the skin is usually followed by the formation of a new section of the rattle, and since as many as three or four sheddings may occur in a year, that number of segments may be added to the rattle. The number of rattles divided by three would give a better indication of the reptile's age although this system would by no means be accurate since the sections are occasionally broken off.

"WHENEVER someone is bitten by a rattlesnake, there is usually one person in the party who thinks that whisky should be given. That's a mistake.

"If the patient has a weak heart or has fainted, a stimulant may be needed. But alcohol is not a stimulant. Plenty of alcohol will neatly finish what the venom has started. Black coffee, aromatic spirits of ammonia, and strychnine are stimulants.

"The tissues about the wound shouldn't be injured through the use of potassium permanganate which is now known to be of no value as an antidote. Snake bite cures and home remedies also should be ignored. If antivenin is at hand, it should be administered."

Another refutation of the "rattler" yarns is supplied by the work of Mrs. James B. Reidy, noted snake hunter of the Southwest. Disproving the prevailing idea of the tenderfoot that a rattler lurks behind every cactus on the desert, ready to strike, Mrs. Reidy has many times searched for several days without finding a snake. She has killed literally thousands of reptiles and has never been bitten, or even had a close call. She sets forth early in the morning, before the heat of the day has driven the serpents into their holes, and finds a nest of them taking sun baths. She waits until one points its head and starts to strike. Then she quickly pins its head to the ground with a bamboo fish pole, and the trick is done. Even if she misses, she knows that the rattler can strike only for a certain distance, and she keeps beyond that range. She uses the white vertebrae of the snakes in the making of beads.

THE big bull snake, which lumbers across the desert much like the rattler and sends sightseeing tourists scurrying, makes a delightful pet. He wouldn't bite anyone and is quite affectionate when fed. The bull snakes are the ones often used at snake ceremonials where Indians and also white men thrill the customers by handling the reptiles, most of the spectators believing that real rattlesnakes are being used. The Hopis, though, and occasionally other tribes, do actually dance through uncanny and creepy rituals with rattlers in their mouths.

Another reptile popularly thought to be deadly is the bright coral snake. It is slender and small, its length seldom exceeding two

HOW TO TAKE RATTLERS ALIVE

Mrs. James B. Reidy, famous snake expert of the Southwest, uses a fishing pole in capturing rattlesnakes and bringing them in alive

feet. Of all creatures of the sands, it is among the most variegated in colors, its body being marked with bands of black, yellow, and red.

While it is related to some of the most deadly species on earth and its venom is more poisonous drop for drop than that of any other desert reptile, Dr. Vorhies hasn't found a record of a fatality. This is because of its small size. The fangs are not big enough to penetrate the usual covering of clothing. Desert rats report that they have never known the coral to bite except when touched.

"The coral snake ruins two common erroneous ideas," the desert scientist points out. "It is usually thought that a large, angular head, like that of a rattler, indicates a poisonous type and that a small rounded head is harmless, also that the brightly-colored reptiles are non-poisonous. The coral has a small rounded head and is also gayly marked, while the harmless milk and king snakes are very similar in appearance and have exactly the same colored bands but in different succession of colors."

FRIGHTENING in its appearance, a regular scourge of the wastelands, is the tarantula. The greatest respect is paid it. Yet an investigation by Dr. Vorhies revealed that the tarantula in the first place is not very apt to attack and secondly, its bite is neither painful nor serious. In a survey that he made of physicians in a desert city of forty thousand, he found only seven cases of tarantula bite in some one hundred aggregate years of practicing medicine.

"Tarantulas are not nearly so prone to bite as is supposed," he asserts, "and the resulting injury, while sometimes quite severe, is hardly to be considered dangerous to life for the average healthy, full-grown individual. For a child, the bite might be serious and possibly fatal. Even among children, though, I know of only one fatality and that one wasn't fully authenticated."

Why the tarantula is not as poisonous as a rattlesnake was clearly revealed by Dr. Vorhies in his laboratory. By microscopic examination of tarantulas, he found that the jaws, while large for a spider, cannot be compared to a snake's fangs. Consequently there is little likelihood that they can pierce into any good-size blood vessel and inject poison that might be carried speedily to the vital organs.

As in the case of all lacerations or wounds, the seriousness of any bite varies greatly, of course, with the victim's physical condition. It is difficult to isolate the effects of the venom when other complications enter in, and many deaths attributed to the queer desert denizens are due entirely or in large part to other basic causes peculiar to one's system.

CLOSELY related to the spider family is the scorpion. Indigenous to the deserts, they invade homesteads and cabins by the hundreds on rainy nights, giving rise to spooky recitals of "how the very floor seemed to waver like ripples on a lake."

"Many believe it's time to make their will when they're stung by the scorpion," Vorhies says. "And yet the sting is no more likely to cause death than that of a common honey bee. Many conflicting reports on the scorpion indicate that species in other countries may be deadly, even to adults. These, though, are far larger than those in the United States, and certainly the scorpions here are far from being of serious consequence."

The scorpion is queerly constructed. At a casual glance, it appears headless. It can't bite because it hasn't the right mouth parts. It has vicious-looking pincers but they lack the power to crush small victims to death. But it does have an elongation of its abdomen, an appendage that looks like a tail and is often two or three inches long, which it can thrust over its body. The tail ends in a fine needle which tapers off from a small bulb of poison. When the scorpion throws its tail over its head and plunges it into a prospective meal, dinner is only a minute away.

THE method by which the scorpion kills tiny victims was learned by Dr. Vorhies in experiments conducted with insects. By placing small bugs in glass bowls and cages with a hungry scorpion, he has been able to watch its means of attack. Besides making a quick thrust with its tail, it often bores into its prey. From this, Dr. Vorhies deduces that the scorpion does likewise with human beings when it is trapped in a bed or elsewhere. Unable to strike, it begins to work the stinger into the flesh, releasing its poison at the same time.

Among the most poisonous of desert denizens is the Black Widow spider, sometimes called the Shoe Button. There are few myths about it to explode. Its poison is believed by many scientists to be even more deadly than that of the rattlesnake. Before the coming of the white men, Indian warriors would dip their arrows into pots of the poison, thus insuring death as the slender missiles sped into covered wagon trains.

Few die today, though, of the Black Widow's bite. Although the spider is fairly common, it seldom attacks. When it does, the victim usually suffers intensely for days, perhaps even weeks. Now and then someone dies of the poison. The Black Widow is only about the size of a pea or shoe button. It is shiny black with red or yellow markings, resembling an hour glass, under the body.

In stripping the desert of its terror, Dr. Vorhies points out how wild yarns have infused fear into millions over creatures that are not dangerous, such as the Gila monster and scorpion, but have ignored the flies and mosquitoes which, while not poisonous in themselves, carry the germs of death to thousands every year.

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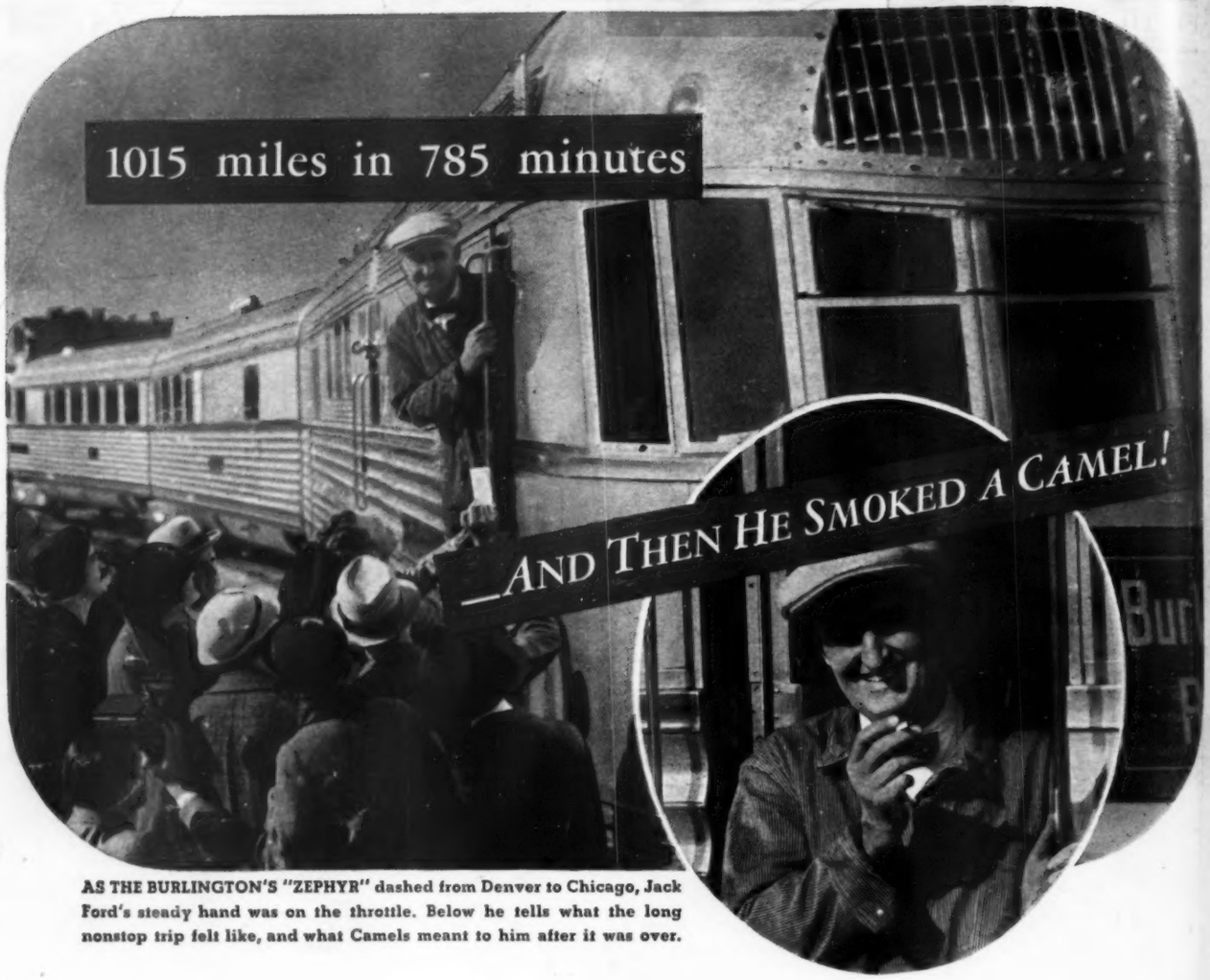

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